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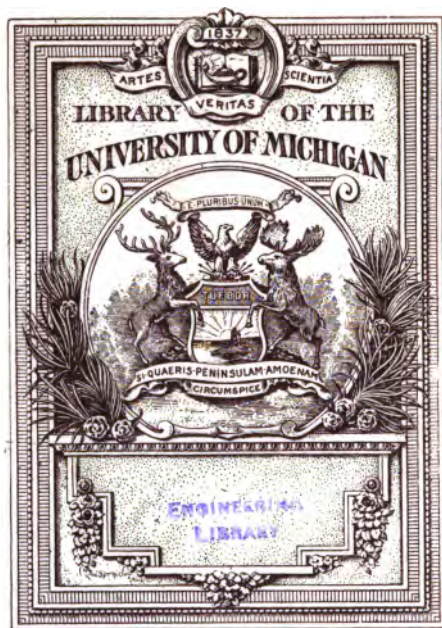
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ANNUAL REPORT
OF THE
STATE ENGINEER AND SURVEYOR
ON THE
CANALS OF NEW YORK

MADE JANUARY 21, 1867.



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ANNUAL REPORT

OF THE

STATE ENGINEER AND SURVEYOR

ON THE

CANALS OF NEW YORK,

FOR THE YEAR 1866.

TRANSMITTED TO THE LEGISLATURE JANUARY 21, 1867.

ALBANY:
C. VAN BENTHUYSEN & SONS, PRINTERS.
1867.



State of New York.

No. 27.

IN ASSEMBLY,

January 19, 1867.

ANNUAL REPORT

OF THE STATE ENGINEER AND SURVEYOR ON THE CANALS
OF NEW YORK, FOR THE YEAR 1866.

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, *January 19th*, 1867. }

To the Hon. EDMUND L. PITTS,

Speaker of the Assembly:

Sir—I have the honor to transmit herewith to the Legislature
the Annual Report of the State Engineer and Surveyor, for the
year ending September 30th, 1866.

Very respectfully,

J. P. GOODSELL,

State Engineer and Surveyor.

REPORT.

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, January 19, 1867. }

To the Honorable the Legislature of the State of New York:

The State Engineer and Surveyor, in obedience to the provisions of act chapter 377, Laws of 1850, has the honor to submit herewith his

ANNUAL REPORT FOR THE YEAR 1866.

ENGINEER DEPARTMENT.

Under the provisions of act chapter 169, Laws of 1862, which declared all contracts for the enlargement and completion of the canals of this State, as contemplated by section three of article seven of the Constitution, to be completed, it was provided that after the first day of September, 1862, no more than one engineer and one assistant engineer should be employed upon each division of the State canals.

By act, chapter 477, Laws of 1865, the above act was amended, and the "engineers" and "assistant engineers" were respectively designated as "division engineers" and "resident engineers."

Act chapter 794, Laws of 1866, authorized the Canal Board to appoint a resident engineer for the extension of the Chenango canal.

But seven engineers are therefore recognized by law as existing official engineers.

The subordinate engineers are appointed by the Canal Commissioner and State Engineer, on the recommendation of the division engineer.

The offices for the division and resident engineers are located respectively as follows:

For the Eastern Division at Albany;
 For the Middle Division at Syracuse; and,
 For the Western Division at Rochester.

An office for the resident engineer on the Chenango canal extension has been established at Owego.

The expenditures on account of engineering have been \$57,577.55.

Amount of work done under the supervision of the department.

| Names of the canals. | Amounts. | Total. |
|----------------------------------|--------------|----------------|
| Erie canal | \$331,258 88 | |
| Champlain canal improvement | 159,973 08 | |
| Chenango canal | 50,853 09 | |
| Oswego canal | 161,353 27 | |
| Cayuga and Seneca canal | 2,509 36 | |
| Genesee Valley canal..... | 100,306 50 | |
| Black River canal..... | 17,820 00 | |
| Chemung canal and feeder | 96,706 12 | |
| Chenango canal extension | 218,120 00 | |
| Albany basin..... | 19,960 00 | |
| | <hr/> | \$1,158,860 30 |
| | | <hr/> <hr/> |

The cost of engineering equals $4\frac{9}{100}$ per cent of the amount expended.

The State canals, for convenience in construction and the superintendence of repairs, have been divided into three general divisions—Eastern, Middle and Western—each in the charge of one Canal Commissioner and one division engineer.

EASTERN DIVISION.

| Names of the canals. | Miles. |
|--|--------|
| Erie canal, from Albany to east bank of Oneida Lake canal, | 133.58 |
| Albany basin (called one mile for tolls by chap. 200, Laws of 1849)..... | .77 |
| Port Schuyler and West Troy side cut | .35 |
| Pond above Troy dam..... | 3.00 |
| Champlain canal and Waterford side-cut..... | 66.00 |
| Glen's Falls feeder and pond above..... | 12.00 |
| Black River canal..... | 35.33 |
| Black River feeder and pond above dam..... | 12.09 |

STATE ENGINEER AND SURVEYOR.

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| Names of canals. | Miles. |
|-------------------------------|---------------|
| Delta feeder | 1.38 |
| Black River improvement | 42.50 |
| Total miles | <u>307.00</u> |

This division is in charge of Daniel C. Jenne, division engineer.

MIDDLE DIVISION.

| Names of the canals. | Miles. |
|--|---------------|
| Erie canal, from east side of Oneida lake canal to the east line of Wayne county | 68.58 |
| Oneida Lake canal | 6.00 |
| Oswego canal | 38.00 |
| Cayuga and Seneca canal | 22.77 |
| Crooked Lake canal | 8.00 |
| Chemung canal and feeder | 39.00 |
| Chenango canal | 97.00 |
| Oneida River improvement | 20.00 |
| Seneca River towing-path | 5.00 |
| Baldwinsville canal | 1.00 |
| Cayuga inlet | 2.00 |
| Limestone feeder | .80 |
| Butternut feeder | 1.55 |
| Camillus feeder | 1.00 |
| Total miles | <u>310.70</u> |

This division was in charge of J. P. Goodsell, division engineer, to January 1st, 1866, and of W. H. H. Gere, division engineer, from February 1st, 1866.

WESTERN DIVISION.

| Names of canals. | Miles. |
|---|---------------|
| Erie canal, from east line of Wayne county to Buffalo ... | 148.50 |
| Genesee Valley canal, from Rochester to Millgrove | 113.50 |
| Dansville branch of this canal, from junction at Spraker's to Dansville | 11.00 |
| Total miles | <u>273.00</u> |

Navigable Feeders..

| | |
|---|---------------|
| Genesee river feeder at Rochester | 2.25 |
| do do Oramel | .75 |
| Total miles | <u>276.00</u> |

The Western Division was in charge of O. W. Story, division engineer, to July 1st, 1866, and of Walter W. Jerome, resident and acting division engineer, since that date.

The Chenango canal extension has been in charge of Byron M. Hanks, resident engineer, from the 15th day of June, 1866.

From the above statements it will be seen that there are 893.70 miles of navigable canals and feeders, and there are also 5.68 miles of unnavigable feeders, making a total of 899.38 miles of canals and feeders under the supervision of this department, exclusive of the Chenango canal extension, in process of construction.

CHAMPLAIN CANAL IMPROVEMENT.

Regarding this canal as one of the most important arms in our system of internal improvements, all efforts to facilitate and cheapen transportation through its channels become of great public interest, as well as of vital importance to the northern portion of our State.

Act, chapter 186, Laws of 1864, authorized "the improvement of the navigation of the Champlain canal and Glens Falls feeder, in such manner as to give, in the entire length of each, a depth of five feet of water and a uniform width of thirty-five feet on the bottom, as near as it can be judiciously done, in the opinion of the Canal Board, and to complete the work of stopping the leaks on the Glens Falls feeder. The estimated cost of the improvement was \$526,898.48.

There has been appropriated as follows:

| | |
|--|---------------------|
| Under act, chapter 186, Laws of 1864 | \$295,000 00 |
| Under act, chapter 156, Laws of 1866 | 247,500 00 |
| Total | <u>\$542,500 00</u> |

The excess of appropriation, \$15,601.52, over the estimated cost, at contract prices, will undoubtedly be required in miscellaneous expenditures authorized by the Canal Board.

The benefits of these improvements are intended to be fully realized on the opening of navigation the coming spring.

Another improvement required and not provided for in the appropriation already made, is to enlarge the remaining locks, six in number, so as to conform in dimensions to the improved locks, as authorized by the constitutional amendment of 1864. This work is important, not to say absolutely necessary, to make available to its full extent the improvement of the prism.

The "Moses Kill" lock will be enlarged and completed by the opening of navigation, 1867.

Embodied in this report will be found the report of the division engineer, giving a full account and details of this work, with statements of expenditures for work done and to be done.

CHENANGO CANAL EXTENSION.

The work on this important improvement has been vigorously prosecuted during the past year.

The following statement will show the condition of the work:

| | | |
|---|-------------|-----------------------|
| Work under contract at contract prices..... | \$1,120,946 | |
| Estimated cost of work not under contract | 424,856 | |
| | <hr/> | \$1,545,802 |
| Amount appropriated by act, chapter 185, Laws of 1865 | \$550,000 | |
| Amount appropriated by act, chapter 649, Laws of 1866..... | 275,000 | |
| | <hr/> | 825,000 |
| Leaving a deficiency of..... | | <hr/> <hr/> \$720,802 |

There has been expended on this work up to October 1st, 1866, the sum of \$234,760.

It will be seen that the appropriations thus far made, do not cover the cost of the work under contract, as will appear by the following figures:

| | | |
|------------------------------|-------------|-----------------------|
| Work under contract..... | \$1,120,946 | |
| Amount appropriated | 825,000 | |
| | <hr/> | |
| Leaving a deficiency of..... | | <hr/> <hr/> \$295,946 |

The length of this extension is 40½ miles from its junction with the Chenango canal at Binghamton, to the Pennsylvania State line, where it is to be met by an extension of the North Branch canal of Pennsylvania.

The southern terminus has not yet been definitely determined upon. In the estimated cost to complete the work, the cheapest line has been assumed.

Regarding this work as of great importance to the people of the southern and central portions of the State, I would recommend that the necessary appropriation be made, to ensure its completion by the first of May, 1868, or May, 1869, at the farthest.

In the report of the division engineer of the middle division, and of the resident engineer in immediate charge of the construction of the work, which reports are embodied herewith, a full description of the condition and character of this work will be found.

ENLARGEMENT OF ONE TIER OF LOCKS.

The time seems to have arrived when it is evidently the true policy of the State to initiate and perfect as speedily as possible some plan to increase facilities of transit and cheapen transportation over the main lines of our canal communication between tide water and the lakes.

The great producing and shipping interests of the West are active and earnest in seeking some outlet that shall cheapen the cost of transportation and lessen the risks and delays they are now subjected to in passing through our State.

This desire is rational, and its intensity must increase until that relief is found, either partial or complete. I do not doubt the propriety or necessity of making every proper and judicious effort to retain through our own lines of communication, so long established, the great market highways between the seaboard and the West. They are a part of our history, are among the chief sources of our prosperity, and have become a necessity for our people.

The plan of the enlargement of the capacity of the locks from the lakes to tide water is the practical solution of the difficulty, and will secure us for the present in the continued control of this great traffic, by furnishing to it a quicker, safer and cheaper route than can be found elsewhere.

But so rapidly is the great West increasing in population and all the elements of national wealth and prosperity, even this relief can only be adequate for a limited number of years.

One tier of enlarged locks, with a capacity of chamber 220 feet in length between the quoins, and a width of 25 feet at the top water line of the lower level, will admit the passage of boats with

six feet draught of water, equal to a tonnage displacement of 684 tons, or a cargo of 500 tons; and with an equal distribution of boats, a capacity of 5,000,000 tons in each direction per season.

The cost of transportation as compared with boats of the present tonnage will be reduced from $2\frac{1}{100}$ to $1\frac{4}{100}$ mills per ton per mile, based upon the movement by horse power.

The experiments thus far made in the use of steam as a motor have been unsuccessful. This result is attributable to the want of capacity in the locks. The room occupied by the power necessary for rapid transit is too great, as compared with the space remaining for stowage of cargo, to make its use economical. This difficulty will be greatly lessened, if not entirely removed, by the use of the large boats.

They will have in length an increase of $2\frac{3}{4}$ diameters over the present class, and conform to the general proportions of length, to beam, adopted by our commercial marine.

That the use of steam for motive power will be at once applied to the enlarged boats I have no doubt, and it is the belief of persons whose practical knowledge of this subject gives to their opinion great value, that the cost of transportation will be reduced thereby from 45 to 50 per cent.

As there are no parallels in the use of steam exactly suiting the condition in which our canals will be placed, with enlarged locks, the problem must be worked out by actual experiment; yet all experiments in cases the most analagous confirm the belief that the results anticipated will be fully realized.

The enlarged locks will in no way interfere with the lockage of boats of the present dimensions. These will still have the use of one tier of locks, as at present existing, while the enlarged locks will have sufficient capacity to receive two boats at a time in cases of emergency, and it is believed that these boats can be passed in much less time than in the present locks, for the reason that they can be put into and taken out of them more rapidly.

Most of the time at present required for locking loaded boats is consumed in forcing the boat into a lock which it almost exactly fills, against a body of water which has no means of escape except by the exceedingly limited spaces between the boat and the bottom and sides of the lock.

It is true that the maximum *season* capacity of the present locks has never been reached, and it is equally true, in my belief, that

such maximum will never be reached unless great reductions can be effected in the present cost of transportation.

The avenues by which the great Western trade can reach the seaboard are numerous. It will of necessity seek those channels by which it can be moved at reasonable rates at those limited seasons to which its movement is generally confined.

If the State of New York can meet these conditions, she will continue to control this traffic; but we must adapt our facilities to the wants of commerce, instead of endeavoring to force the latter to use our canals at those seasons when there is but little occasion for their use.

The movement of the fall crops of the west cannot be forced into the summer months of the same season, and unless we can furnish far greater facilities than we are at present able to offer, they must be driven into other channels, which, although more expensive, will relieve them from the only other alternative—to lie idle until the ensuing summer.

The enlarged locks should be constructed of heavy rubble masonry, with vertical fender-timbers in the chamber, and cast-iron hollow quoins. This change in the character of the masonry from that now in use will materially reduce the cost, and give equal convenience, permanence and durability.

These locks will, wherever double locks now exist, have the benefit of one lock wall already constructed for a length of one hundred and twenty feet, and all the material necessarily removed from the present locks can be used in the enlargement.

The Lockport locks must necessarily be reduced in number from five to three, on account of the peculiarities of location, and these should be built of cut stone.

At such points upon the canals as it may be deemed necessary to economize the use of water, extra gates can be inserted in the center of the enlarged locks, to be used in the lockage of boats of the present class.

If a law authorizing the construction of enlarged locks shall be passed in such time that the Canal Board may place them under contract by the first day of April, they can be constructed and ready for use by the first of May the following year, provided the labor requisite for so vast an undertaking can be procured.

On this point I have serious doubts, especially as regards mechanical labor. So trifling an amount of public works of any kind have been in progress in our State for the past five or six

years, that this kind of labor has sought employment elsewhere, and has become so scarce that it has been found difficult to procure enough for the ordinary work upon our canals.

The dictates of prudence in this regard should be carefully heeded, and the time of their completion, perhaps, extended through two seasons. In the meantime, contractors can make their arrangements for labor of every description, and procure and deliver all the materials required for the work, and perfect an organization of forces that would insure success beyond a doubt. If, on the other hand, it should be the judgment of the Legislature that the requisite labor can be procured, it is plainly for the public interest that the work be done in 1 year rather than in 2.

The work can all be done in such time and manner as not to interfere with navigation, or subject the forwarding interests to those delays and embarrassments necessarily imposed upon them during the progress of the late enlargement.

In a report submitted to the Legislature February 4, 1864, by the Hon. Wm. B. Taylor, late State Engineer, will be found a full and elaborate estimate of the cost of enlarging one tier of locks where double locks at present exist, and of constructing single enlarged locks at other points, together with all other work necessary to bring the new locks into successful use. This estimate was made with great care and labor, and, I am satisfied, is safe and reliable as a basis for the cost of the work.

The prices used in the estimates are believed to have been ample at that time, and more than sufficient for the present or future, but it is deemed prudent not to reduce them in order that they may be adequate to cover any possible contingencies that may arise in the progress of the work.

The following is a summary of the cost of enlarging the locks and constructing the work necessary to bring the same into use, as set forth in the above report:

| | |
|--|-------------------------------|
| For enlargement of locks (Erie & Oswego canals), | \$6,888,950 75 |
| do aqueducts and culverts | 268,343 00 |
| do bridges | 121,211 00 |
| For removing wall benches | 1,794,110 00 |
| For additional feeders and reservoirs | 393,134 00 |
| For deepening canal one foot | 1,939,970 00 |
| For land damages and removing buildings | 409,800 00 |
| For engineering and contingencies | 1,067,651 00 |
| Total | <u><u>\$12,883,169 75</u></u> |

By substituting rubble masonry and cast iron hollow quoins for the masonry provided for in the above estimate, and dropping from the estimate the cost of one guard lock on the Oswego canal, (which by a change of plan it will be unnecessary to build,) a reduction in the cost of locks can be effected of \$933,826, making the estimated cost of one tier of enlarged locks \$5,955,124.75. Other items embraced in above estimates, (except for deepening canal one foot,) \$4,054,249.00. Total estimated cost of enlarging locks and bringing same into use, \$10,009,373.75.

The expediency of deepening the present canal one foot while retaining its present limited width, may be considered at least doubtful, and the cost of that item amounting to \$1,939,970 is not included in the above estimate.

If experience in the use of steam, in boats of the dimensions proposed should demonstrate the necessity of obtaining an additional depth of canal, the work can be performed without additional expense on account of the delay.

The sum of \$1,794,110 required for removal of old wall-benches, and included in the estimate, should not properly be considered as necessarily belonging to this contemplated improvement, as this work is requisite to improve the working capacity of the canals even with the present locks, and its importance has been repeatedly urged upon the attention of former Legislatures.

If this last item is omitted from the estimate, it will stand as follows:

| | |
|--------------------------------|-----------------------|
| For enlargement of locks | \$5,955,124 75 |
| For other necessary work | 2,260,139 00 |
| Total | <u>\$8,215,263 75</u> |

BRIDGES.

The total number of bridges upon all the State canals, is one thousand three hundred and eighteen, as follows:

Upon the enlarged canals, viz: The Erie, Oswego, and Cayuga and Seneca, bridges of not less than seventy-two feet clear span:

| | |
|---|-----|
| Street and road bridges of iron | 161 |
| do do do wood | 236 |
| Farm do do iron | 6 |
| do do do wood | 192 |
| Tow path and change bridges of iron | 1 |
| do do do wood | 31 |

Bridges of not less than fifty feet span, located upon the Champlain, Chenango, Black River, Oneida Lake Chemung, Crooked Lake and Genesee Valley canals:

| | |
|---|-------------------|
| Street and road bridges of iron..... | 19 |
| do do do wood | 328 |
| Farm do do wood | 320 |
| Tow path and change bridges of wood | 24 |
| | <hr/> 691 |
| Total | <hr/> 1,318 <hr/> |

The wider and more expensive bridges, being chiefly located in cities and villages, have mostly been rebuilt in a permanent manner of iron. The total number of iron bridges on all the canals is 187, of which 180 are on streets and roads.

There still remain of wood superstructures 1,131, of which 564 are upon roads and streets. These bridges require rebuilding as often at least as once in eight years, and it has become a serious question, whether the best interests of the State do not require that at least the street and road bridges shall all be replaced, whenever failures of the present superstructures occur, by permanent iron structures.

This would require a much larger present outlay than would the renewal of the wood structures, but when once built, a heavy annual drain upon the canal revenues would be stopped, and the only serious item for maintaining them in future, would consist in occasional renewal of the floors or road-ways.

Many of these bridges are at present, and it is presumed that many more will, in the future, be used by street railroads. Most of them are much used by heavily laden teams in crossing the canals, and owing to the rapidity with which they decay and become insecure after the first five or six years, they are a constant source of apprehension and annoyance.

On the other hand, the iron superstructures are permanent and secure, and at once cease to be a source of anxiety to those who are compelled to use them, and also cease to figure in the estimates of bidders for canal repairs, in which they now constitute a most important item.

The following shows the estimated cost of rebuilding all the superstructures of street and road bridges of wood:

| | |
|---|------------------|
| 236 street and road bridges of not less than 72 feet span, at \$850 | \$200,600 |
| 328 street and road bridges of not less than 50 feet span, at \$530 | 173,840 |
| Total | <u>\$374,440</u> |

The reconstruction of the above in each eight years involves an annual expenditure of \$46,805 at the above estimate of cost.

The estimated cost of rebuilding the above bridges of iron is as follows:

| | |
|---|------------------|
| 236 street and road bridges of not less than seventy-two feet span, \$2,170 | \$512 120 |
| 328 street and road bridges of not less than fifty feet span, \$1,340 | 439 520 |
| Total | <u>\$951 640</u> |

The above estimate would require an annual expenditure of \$118,955 for eight years, or \$95,164 for ten years, after which all expense from this source would cease, except for a periodical renewal of the roadways.

At a meeting of the Canal Board, held at the Canal Department on the second day of October last, the following resolution was offered by the State Engineer and Surveyor, and was adopted by the Board:

Resolved, That in the opinion of the Canal Board, whenever it shall become necessary, to rebuild any road or street bridge on any of the canals of this State, that the same should be rebuilt, or reconstructed of iron, and that all resolutions of this Board conflicting with this declaration are hereby repealed.

It is respectfully recommended that the legislation necessary to enable the Canal Board to carry out the plan embraced in the above resolution may be had.

NAVIGATION OF THE CANALS.

The interruptions to navigation, consequent upon the occasional, not to say frequent, occurrence of breaks, is a very serious cause of complaint to those engaged in shipping and transportation. These accidents will of necessity occur, but a judicious system of increased protection applied at all dangerous points will greatly lessen the risks and frequency of such interruptions.

The more important embankments along the margin of the Mohawk river, at Montezuma, Cartersville, Holly, and other points, should be thoroughly watched and guarded, and all the precautions used and remedies applied that discretion and foresight may deem adequate.

Your attention is respectfully called to the suggestions and recommendations relating to this subject, which are contained in the reports of the division engineers having more particular charge of the work, which are embodied in this report. These recommendations are fully endorsed.

The necessity for the removal of what are called the "wall benches," and the substitution therefor of slope wall, on the plan adopted by the Canal Board, is becoming every year more apparent.

The tendency of the bench or berm which underlies the wall, to settle and slough into the prism, materially obstructs and embarrasses navigation by lessening the bottom width of the channel, and by the settling and sliding of the wall interferes with the safety and usefulness of the banks themselves. By its removal and the substitution of a wall starting at canal bottom, the cross-section area of the water-way is increased, the banks are secured, boats can be moved more rapidly, and the danger of grounding on the slopes avoided.

At West Troy the locks upon the upper side-cut leading into the Hudson river (two in number) are single. The necessity for doubling the same is becoming imperative from the increase of business seeking outlet to the river at this point.

The following statement of lockages for the past year will show the distribution :

| | |
|---|--------|
| Lock No. 1, Albany, double | 6,099 |
| do 2, Albany, single | 12,303 |
| do 3, West Troy junction, double | 27,331 |
| Upper side-cut, West Troy, single | 17,170 |
| Lower side-cut, Port Schuyler, single | 5,971 |

Under act, chapter 503, Laws of 1866, the improvement of the Albany basin has been placed under contract and the work is in a forward state. The improvement will be completed in time to realize the benefits expected to be derived therefrom early the ensuing season.

A vertical wall should be erected on the berme side of the canal, between the big basin and Clay street, in the city of Utica. The berme has been dredged out, but no protection wall has been put in, whereby the navigation is embarrassed at that point.

A vertical wall from the foot of lock No. 48, to the head of lock No. 49, in the city of Syracuse, is urgently needed to facilitate the navigation on that important level. The estimated cost is \$29,811.91.

The completion of the improvement of the Nine Mile Creek feeder, authorized by act chapter 72, Laws of 1863, is of great importance, and should be prosecuted without delay. An appropriation of \$2,200 is required to complete the work and pay balance due for work already done.

The heavy embankments across the Montezuma marshes are not sufficiently strong to bear safely the great pressure upon them. A breach in this work would suspend navigation for weeks, as no material for repairs is to be found in the vicinity, and the consequent cost and delay, in case of disaster, would be very great. The banks need strengthening and securing in nearly their entire length, and it is urgently recommended that an appropriation of \$30,000, as suggested in the report of Mr. Gere, the engineer of this division, be made, for the purpose of securing immediately the more dangerous points.

The engineer of the Western Division reports that a portion of the towing-path bank on section 366, requires protection from the rapid currents of the Niagara river. An appropriation of \$8,700 is recommended for this purpose.

The use of the weigh-lock at Rochester is much embarrassed in consequence of the difficulty of ingress and egress caused by the peculiar conformation of the canal at that point. An appropriation of \$7,300 is recommended for the purpose of straightening the berme bank and constructing a vertical wall at that point.

The reconstruction of the locks on the Chenango canal is a question of serious importance. The original locks were mostly of the composite order. Their entire number was 114, of which four were of cut stone, and eight have been rebuilt. These locks are fast going to decay, and many of them require immediate reconstruction. The division engineer in charge states that Nos. 52, 55, 61, 65, 78 and 79 should be rebuilt the ensuing season.

I respectfully urge upon the Legislature the necessity of the adoption of a system looking to the reconstruction of the locks

upon this canal, which will require rebuilding within a period of ten or twelve years. This would require an annual appropriation of \$65,000.

The high dam upon the Oswego canal is one of the most important and expensive structures upon that canal. Under act chapter 470, Laws of 1865, all of the dams upon this canal were authorized to be rebuilt of stone. Most of these dams have already been reconstructed, or are in process of construction.

This dam is, by the report of the division engineer in charge, pronounced unsafe and its reconstruction recommended. Before this is done it is suggested that a comparative estimate be made to ascertain whether it would not be better economy to build a guard bank in the river, with a view to establish an independent canal between locks Nos. 14 and 15, than to reconstruct the dam upon a new site.

Increased harbor facilities are required at the village of Watkins, at the head of Seneca lake and foot of the Chemung canal. The large and rapidly increasing business, at this point, growing out of the transshipment of coal from cars to boats of the large class, renders the erection of a breakwater, one thousand feet in length, indispensable to the security and safety of boats lying in the harbor, and also the dredging of such increased area of harbor, to accommodate boats of this class. The estimated cost of this improvement is \$50,000.

The attention of the Legislature is particularly invited to the full, careful and thorough reports of the division engineers, which are embodied in this report, and which contain all the details relating to the management and the requirements of the various canals of the State.

SURVEY OF MARINE HOSPITAL GROUNDS.

Act, chapter 751, Laws of 1866, entitled "An act in relation to quarantine in the port of New York, and providing for the construction of the permanent quarantine establishment," provides as follows:

SEC. 7. Immediately after the passage of this act, the said board of commissioners mentioned in the foregoing first section, shall cause the real estate owned by the State in the town of Castleton, formerly used for quarantine purposes, and known as the marine hospital grounds, except that portion of the southeast corner of said grounds which is bounded and described as follows, to wit:

"All that certain piece or parcel of land commencing at a point on the lands under water, distant fifty feet northerly from the northeasterly corner of the new quarantine dock, and running thence westerly on a line parallel with the boundary line between the lands of the United States and said marine hospital grounds, to the fence now erected on said grounds, in the rear of the health officer's residence; thence southerly along said fence to Arietta street; thence easterly along said street to a point on the land under water, which would be found by the intersection of the southerly line of said grounds with the easterly line extended of said new dock; and thence northerly along said easterly line of said new dock to the point or place of beginning," to be surveyed out into lots and blocks, making provision for such streets through the the same as may be necessary, and three accurate maps of the same, made by the State Engineer and Surveyor, under direction of said board.

In obedience to the foregoing requirements, the State Engineer and Surveyor organized a party, under the immediate direction of J. Nelson Tubbs, Esq., civil engineer, and caused the necessary surveys and maps to be made under the direction of the aforesaid board of commissioners.

SURVEY of a route for a railroad from the City of Schenectady to a point on the St. Lawrence river at or near the village of Ogdensburgh.

Act chapter 897 Laws of 1866, directed the State Engineer and Surveyor to appoint a competent and experienced engineer, whose duty it shall be to explore a route for a railroad commencing at the city of Schenectady, or at the most favorable point to reach and develop the State lands, or at such a point in its vicinity as shall be most eligible and convenient, and continue such survey in the most direct and feasible route to a point on the St. Lawrence river, at or near the village of Ogdensburgh, in St. Lawrence county.

The appointment of Richard Franchot, Esq., as superintending engineer, was made early in the season, and a full party put in the field as soon as a perfect organization could be effected.

The field work is being rapidly pushed forward, and nearly one half of the route examined. It was impossible, owing to the peculiarities of the country and climate in that region, to complete the surveys during the past season.

Survey of the Hudson River and Champlain Canal.

A survey of the Hudson river, from tide-water to Fort Edward, to test its practicability for purposes of navigation; also a survey of the Champlain canal, from tide-water to Lake Champlain, for an estimate of the cost of the enlargement of the same, was authorized by act chapter 33 Laws of 1866.

These surveys were placed under the charge of Samuel McElroy, Esq., an engineer of ability and large experience, and the field work begun in June.

The work is progressing satisfactorily, and it is believed the estimates, maps and plans required to be submitted to the Canal Board on the first day of January next, can be nearly if not quite completed by that time.

This is a work requiring a great amount of labor and calculation, and the appropriation made by said act to defray expenses, it is believed, will be inadequate to that end.

Improvement of the Hudson River.

Act chapter 491 Laws of 1866, designated the State Engineer and Surveyor as one of the commissioners for the improvement of Hudson river between Troy and New Baltimore.

This important subject has received the careful consideration of this department, and the report of the commissioners of the results accomplished, the expenses incurred, and the application of the money received, is hereto attached.

Maps of the Enlargement.

The sum of \$6,730.37 was appropriated by act chap. 543 Laws of 1866, for the purpose of defraying the expenses, under the direction of the Canal Board, of finishing and completing the maps of the enlargement and completion of the canals of the State, which have hitherto remained unfinished for want of funds.

By a resolution of the Canal Board, passed September 18, 1866, this work was placed under the direction of the State Engineer and Surveyor.

A uniform style of map has been adopted for all the canals, and the work is progressing satisfactorily. The maps, when completed and approved by the Canal Board, will become the official maps for the Canal Department.

Respectfully submitted,

J. P. GOODSELL,

State Engineer and Surveyor.

EASTERN DIVISION.

DIVISION ENGINEER'S OFFICE, }
ALBANY, Oct. 15, 1866. }

Hon. J. P. GOODSSELL, *State Engineer and Surveyor*:

Sir—The regulations established under act chapter 169, Laws of 1862, require that each division engineer shall report annually the condition of all work in progress, and the number and compensation of all persons employed in the engineer department during the year, on his division.

In obedience to the same I have the honor to present my

ANNUAL REPORT

on the Eastern Division of the New York State canals for the fiscal year ending September 30th, 1866.

The navigable canals, river improvements and feeders remain the same as last year, and are as follows:

| | |
|---|---------------|
| Erie canal from Albany to east bank of Oneida Lake canal | 133.58 |
| Albany Basin (called one mile for tolls by chapter 200, Laws of 1849) | .77 |
| Port Schuyler and West Troy side cut | .35 |
| Pond above Troy dam | 3.00 |
| Champlain canal and Waterford side cut | 66.00 |
| Glens Falls feeder and pond above | 12.00 |
| Black River canal | 35.33 |
| Black River feeder and pond above dam | 12.09 |
| Delta feeder | 1.38 |
| Black River Improvement | 42.50 |
| Total Eastern Division | <u>307.00</u> |

The other feeders and reservoirs are as follows:

FEEDERS.

| | |
|--|-------------|
| Mohawk river at Rexford Flats..... | 0.39 |
| Schoharie creek..... | 0.63 |
| Mohawk at Rocky Rift..... | 3.92 |
| Mohawk, south side at Little Falls..... | 0.19 |
| Mohawk, north side, at Little Falls..... | 0.50 |
| Mohawk at Rome..... | 0.05 |
| Total length unnavigable feeders..... | 5.68 |

RESERVOIRS.

| Names. | Area of surface, acres. | Average area, acres. | Depth feet. | Capacity cubic feet. |
|---|-------------------------|----------------------|-------------|----------------------|
| Woodhull..... | 1,236 | 1,118 | 18 | 876,550,000 |
| North Branch, which can be filled twice yearly, | 423 | 277 | 28 | 310,000,000 |
| South Branch..... | 518 | 372 | 26 | 421,190,000 |
| Totals..... | 2,177 | 1,767 | -- | 1,607,740,000 |

SUPPLY OF WATER FOR ERIE CANAL.

| Whence derived. | Distance to be supplied in miles. | Quantity furnished in cub. ft. per min. | |
|---|---|--|--------|
| Champlain canal, from Mohawk river at Cohoes. | 7 | 6,570 | |
| Mohawk river at Rexford Flats | 20 | 10,979 | |
| Schoharie creek | 25 | 6,800 | |
| Mohawk river at Rocky Rift | 27 | 10,602 | |
| Mohawk river at Little Falls | 9 | 12,643 | |
| Ilion creek | 800 | 48 | 16,296 |
| Chenango canal at Utica | 911 | | |
| Butts' creek, 2½ miles east of Rome.. | 1,400 | | |
| Mohawk and Black rivers at Rome... | 11,766 | | |
| Black River canal at Rome | 1,294 | | |
| Wood creek at Rome | 125 | | |
| Total | | | 63,890 |

SUPPLY OF WATER FOR CHAMPLAIN CANAL.

From junction with the Erie canal at West Troy to one mile north of Waterford, a distance of five miles, the supply is from

the Mohawk river at Cohoes; from one mile north of Waterford to the crossing of the Hudson river $2\frac{1}{4}$ miles south of Fort Miller, a distance of 25 miles, the supply is from the Hudson river at Saratoga dam; from Saratoga dam to Whitehall, a distance of 35 miles, the supply is from Glens Falls feeder and Wood creek.

SUPPLY OF WATER FOR BLACK RIVER CANAL.

From junction of Erie canal at Rome to lock No. 9 at Mohawk aqueduct, seven miles, the supply is from the feeder from Mohawk river at Delta; from lock No. 9 to lock No. 34, ten miles, the supply is from Lansing Kill feeder; from lock No. 34 to lock No. 102, 17 miles, the supply is from Black River feeder; from lock No. 102 to lock No. 109, $1\frac{1}{2}$ miles, the supply is from pond above dam at Lyons Falls.

The water furnished by the reservoirs (which is drawn only in the very dry season of the year), is passed down through the natural channels of Black river and Woodhull, about twenty miles each, to the pond above dam at head of Black River feeder, thence the necessary quantity is taken into said feeder and passed to the summit level at Boonville. From the summit the canal is supplied both ways. The balance which is designed to supply the Erie canal is passed off at the south end of the summit by a waste weir into the Lansing kill, thence into the Mohawk river, and taken into the Erie canal by the feeders from said river at Rome.

ENGINEER DEPARTMENT.

The number of persons employed in this department on the last day of the fiscal year, besides the division and resident engineer, was eighteen. Of these, nine were employed on the improvement of the Champlain, two on the lock and dam on Black river, and the balance on general repairs, construction of Rexford Flats dam, bridge over the Erie canal at White street, Cohoes, and the improvement of the Albany basin.

The annexed table marked No. 1 exhibits the name, rank, period of service and compensation of all persons employed during the year, and the amount expended for engineering.

All the ordinary repairs of the several canals on this division are under the general supervision of this department, as required by act chap. 169, Laws of 1862, and the expenditures for engineering under this head have been as follows:

| | |
|--|-------------------|
| Repairs of the Erie canal..... | \$3,360 22 |
| Repairs of the Champlain canal | 1,598 80 |
| Repairs of the Black River canal | 1,054 47 |
| Total for repairs | <u>\$6,013 49</u> |

The work on extraordinary repairs ordered by the Canal Board has been under the supervision of this department, but the expenditures for engineering have been paid by the Canal Commissioners, and the amount is as follows:

| | |
|--|------------|
| Extraordinary and ordinary repairs, Erie canal.... | \$1,460 50 |
| Expenditures for engineering on improvement of Champlain canal | 10,030 12 |
| Expenditures for engineering on improvement of Black river, under act chap. 151, Laws of 1864 .. | 1,014 50 |
| Expenditures for engineering on improvement of Albany basin, under act chap. 503, Laws of 1866, | 748 00 |
| Total expenditures for engineering for the fiscal year | 19,266 61 |

WORK ON THE DIFFERENT CANALS.

The amount of work done during the fiscal year on all the canals of this division, under the supervision of this department, is as follows:

| | |
|--|----------------------------|
| Miscellaneous repairs Erie Canal | \$90,730 04 |
| Extraordinary do | 53,320 53 |
| Total Erie canal | <u>\$144,050 57</u> |
| Miscellaneous repairs Champlain canal, | \$4,518 58 |
| Improvement of do | 159,973 08 |
| Total Champlain canal | <u>164,491 66</u> |
| Miscellaneous rep's Black River canal, | |
| Improvement of Black river | \$17,820 00 |
| Total Black River canal | <u>17,820 00</u> |
| Improvement of Albany basin, act chap. 503, Laws of 1866 | 19,960 00 |
| Total work done | <u><u>\$346,322 23</u></u> |

The work done on ordinary repairs by the superintendents and repair contractors, subject to the advice and direction of this department, is as follows:

Erie Canal.

| | | |
|---|-------------|---------------------|
| Section No. 1, by repair contractors .. | \$68,628 00 | |
| do by superintendents..... | 1,782 66 | |
| Total for section No. 1 | | \$70,410 66 |
| Section No. 2, by repair contractors .. | \$27,761 49 | |
| do by superintendent | 17,053 96 | |
| Total for section No. 2 | | 44,815 45 |
| Section No. 3, by repair contractor... | \$16,780 00 | |
| do by superintendent | 11,808 49 | |
| Total for section No. 3 | | 28,588 49 |
| Section No. 4, by repair contractor... | \$22,900 00 | |
| do by superintendent | 8,290 57 | |
| Total for section No. 4 | | 31,190 57 |
| Section No. 5, by repair contractor... | \$12,000 00 | |
| do by superintendent | 2,137 52 | |
| Total for section No. 5 | | 14,137 52 |
| Total for Erie canal | | <u>\$189,142 69</u> |

Champlain Canal.

| | | |
|--|-------------|--------------------|
| Section No. 1, by repair contractor... | \$25,800 00 | |
| do by superintendent | 2,075 10 | |
| Total for section No. 1 | | \$27,875 10 |
| Section No. 2, by repair contractor... | \$19,400 00 | |
| do by superintendent | 3,160 63 | |
| Total for section No. 2 | | 22,560 63 |
| Section No. 3, by repair contractor... | \$12,000 00 | |
| do by superintendent | 356 00 | |
| Total for section No. 3 | | 12,356 00 |
| Total for Champlain canal | | <u>\$62,791 73</u> |

Black River Canal.

| | | |
|--|-------------|--------------|
| Section No. 1, by repair contractor... | \$12,917 83 | |
| do by superintendent | 11,117 62 | |
| Total for section No. 1 | | \$24,035 45 |
| Section No. 2, by repair contractor... | \$7,572 60 | |
| do by superintendent | 3,095 97 | |
| Total for section No. 2 | | 10,668 57 |
| Section No. 3, by repair contractor... | \$9,750 00 | |
| do by superintendent | | |
| Total for section No. 3 | | 9,750 00 |
| Total for Black River canal | | \$44,454 02 |
| Total for all canals | | \$296,388 44 |

All ordinary repair work under contract, except that included in the regular repair section contract, is under the direct supervision of the Engineer Department, and all plans of new structures are furnished from this office. The ordinary repairs embraced in the section contracts are under the special direction of the superintendents.

GENERAL DESCRIPTION OF WORK DONE DURING THE YEAR.

ERIE CANAL.

ORDINARY REPAIRS.

The masonry in the piers on the berme side of the lower Mohawk aqueduct, above bottom of trunk, had become partially displaced by the thrust of the lateral braces to the trunk under which they toed into the masonry. These piers, twenty-five in number, were taken down last spring to bottom of trunk on the berme side and relaid, and each course secured with dowell bolts to the course below. The lateral braces to the trunk had to be replaced. This work has been a good improvement, but still, at the west end, where the canal curves short into the aqueduct, boats very often strike the side of the trunk, and by this means, since the above work was done, the masonry in the first pier from the west end has been again started off below the point where it

was bolted, and it has become necessary to protect the lower end of the pier by extending braces from it, and abutting them into the rock in the bed of the river. The masonry of this part of the work was built too light to receive the strain brought upon it from the lateral braces, and the proper remedy is to brace the centre of the trunk by extending the needle beams outside of the trunk some ten or twelve feet, supporting the ends by a vertical truss, with braces toed into the pier, and putting in additional braces from these needle beams to posts on the side of the trunk, by which means the structure is rendered perfectly secure without any horizontal strain being brought on the piers.

During last winter the trunk of the upper Mohawk aqueduct was rebuilt in a most substantial manner by the superintendent, and is now in perfect order. The berme side of this trunk was similarly strengthened by extending the needle beams and bracing from the same. This plan perfectly answers the purpose designed.

All the timber and plank docking on the berme side, and about one-half on the tow-path, for a distance of about a mile and a half west from Schenectady, was rebuilt last winter by the superintendent, and the materials are all on hand for finishing the balance on the tow-path side. This work, together with the rebuilding of the trunk to the upper Mohawk aqueduct, was reserved from the repair contract of section No. 2 when the same was let.

The weigh lock at Utica has been thoroughly repaired. A scale beam has been inserted on a most appropriate plan, and the old scales carefully adjusted by a competent mechanic skilled in this branch of business. The whole now works with great accuracy and is in every respect an important improvement. Heretofore these scales have been used with a swing platform, with weights placed upon it to determine the weight of boat and cargo, the result being arrived at by counting the number of weights required to balance the boat. By this method errors must occur, while upon the scale beam the exact weight is indicated.

In consequence of the Genesee bridge at Utica not having been raised to the height adopted by the Canal Board when the work was done, a portion of one of the sidewalks was torn off last fall by a passing boat, causing considerable detention and trouble to navigation. Very many of the boats navigating this canal strike this bridge in passing under it, and there seems to be no other remedy but to raise the bridge about one foot higher.

By act, chap. 298, Laws of 1858, amended by act, chap. 297,

Laws of 1863, and by act, chap. 428, Laws of 1865, the Canal Commissioners were required to build a bridge across the canal near White street, in the village of Cohoes, to be paid for from the ordinary repair fund. This work was put under contract in the summer of 1865, and is now progressing. It will be very expensive, as it is probably the most difficult place on the Erie canal to construct a bridge. The superstructure is one hundred and ten feet span. The approaches run each way along parallel with the towing-path about three hundred feet, and require a protection wall in the highest point of twenty-six feet.

On the morning of the 15th of June a very serious break occurred about five miles west of Schenectady, the towing path bank for some 300 feet being carried away to the surface level of the water in the Mohawk river, which, at this point is about twenty feet below bottom of canal. The earth was taken out from bottom for a distance of 150 feet farther, to a depth of some fifteen feet, and the berme bank was washed off to a considerable extent. The repair contractor, assisted by the superintendent, and other State officials, promptly repaired this break at an expense of about \$20,000, the State paying all over \$5,000, according to the terms of the contract. Navigation was suspended nine days, which was the least possible time in which the work could be done. The canal at this point for about half a mile is constructed in part in the channel of the Mohawk river. It is protected on the river side by a heavy rip rap and slope wall. The materials of which the prism is composed is of a sandy formation, not calculated to resist the action of water. As there have formerly been some heavy breaks at other portions of this bank, the only true remedy for making permanent this part of the canal is to take up the inside protection walls, excavate out the bottom and sides to a depth of from one and a half to two feet, and after lining them with good clay and gravel, to replace the walls.

On the 21st of July a break occurred in the bottom and towing path bank of canal, through a culvert located about one mile west of Castle creek, or four miles east of Little Falls. This break was promptly repaired temporarily by stopping up both ends of the culvert, and letting the water flow back over a few acres of land on the berme side. The work was done by the repair contractor. It is not yet decided in what manner to make the permanent repairs after navigation closes, but it is proposed to dispense with the culvert and take the stream into the canal, as there is a waste

wier but a short distance west, and Castle Creek aqueduct, one mile east, and the flood waters from the stream can be very easily passed out of the canal.

At different points several lock-gates have been carried out by boats, and some delay to navigation has been occasioned in consequence of there being no gates on hand ready to put in. The repair contractors should be required to keep, constantly on hand, ready framed gates for the different locks, so that in case of any failure one could be inserted with very little delay.

EXTRAORDINARY REPAIRS.

The work of removing benches and slope wall, and the construction of vertical and slope wall between locks Nos. 1 and 2, has all been completed, and the benefits resulting to the lumber district and the north part of the city of Albany, in the vicinity of the canal, are very plainly developed.

The stone dam across the Mohawk river at Rexford Flats, is now nearly completed. Owing to the action of the water during the past winter, in tearing out the natural rock in the bed of the river, it has been deemed necessary to put in an apron below the dam to prevent undermining the masonry below. This work is in progress, and is performed by sinking cribs of timber, well bolted together, ten feet wide, and filling them with loose stone. The top is coped with hard wood timber, ten inches thick, well bolted to the cribs, and with an inclination of two feet down stream. It is very important that this work be completed, as it will finish up the permanent dams along the Mohawk valley, which are so necessary for the general supply of water for this part of the canal. On account of the inefficiency of the contractor its construction has been delayed for two years, but it will be finished this fall.

The work of concreting the foundation of lock No. 1, was commenced in the winter of 1865, but owing to the sudden high rise of the water of the Hudson river, the coffer dams failed and the work had to be abandoned. It was completed during the past winter, but at a much larger expense than was originally anticipated, owing to the difficulty of bailing and draining the lock. The foundation of locks Nos. 4, 7, 14, 17, 20, 22, 23 and 26, have been thoroughly concreted, and are now all in good order. There are still a few of the locks built prior to 1842, which require that the foundations should be concreted. This work ought to be done

during the coming winter. A portion of the old wall bench west of Castle Creek has been removed and the slope wall raised, and between Mohawk and Frankfort a portion of the bench wall has been removed.

The upper end of Rock Rift feeder has been partially enlarged so as to give a greater capacity and increase the flow of water.

The wall bench and slope of the berme bank between the Big Basin and the Clay street bridge, Utica, has been excavated with a dredge for the purpose of giving greater width to the canal at that point. Where so many boats are allowed to unload their cargoes for the New York Central railroad, on the tow-path side of the canal, a vertical wall should be put in on the berme side between the above points.

The timber docking on the berme side of the canal at Rome, directly west of the freight depot of the Rome, Watertown and Ogdensburgh railroad, was last spring extended 400 feet, to accommodate the increasing business of the canal brought in from that road.

CHAMPLAIN CANAL.

ORDINARY REPAIRS.

The work of rebuilding two piers of the tow-path bridge across the Mohawk river at Cohoes, was completed during the fall of 1865, and the ice breaker of another pier repaired. The masonry of the piers of this bridge was originally built upon cribs sunk below the surface of low water, and the upper end protected by timber cribs filled with stone, and nearly every spring the piers and ice breakers were seriously injured by the ice in high water. The piers, as rebuilt, are constructed of solid masonry, started upon the rock in the bed of the river, with the upper end finished for an ice breaker, by forming an angular point on a slope of six inches to the foot for the whole height of pier, all the stone in the upper end being fastened together with dowel bolts. The two other piers should be rebuilt in a similar manner.

The trunk to the Moses Kill aqueduct has been strengthened on the berme side, by putting in extended needle beams supported by a vertical truss, and the side of trunk braced from the beams. The pier above bottom of trunk has been taken down and relaid, and the stone bolted together.

On the morning of the 11th of May a break occurred at the head of lock No. 5 on the Glens Falls feeder. It was caused by

the head of the sluice around the lock not having been sufficiently repaired, as the Commissioner in charge had personally directed it should be done before the water was let into the feeder. The bulkhead of the sluice was entirely washed out when the break occurred, so that a new location had to be selected and another bulkhead constructed. The repairing of this break and the construction of the bulkhead delayed navigation about five days.

On the 19th day of May a break, which delayed navigation three days, occurred in the berme bank of the canal, in the village of Fort Edward, about one third of a mile south of the lock. It was promptly repaired by the repair contractors. This break was caused by the water in the canal overflowing the bank. It occurred within one hundred feet of a waste weir, and there can be no doubt that if this structure had been in good condition, the gates promptly opened, and proper care and due diligence exercised by the persons in charge of the work, the trouble would not have happened; as from all the information I can obtain there was not a shadow of an excuse for neglect.

On the 30th of May a portion of the sluice around lock No. 12, near Kenyon's mill on the Glens Falls feeder, gave away, and navigation on the feeder was delayed for eighteen hours. The water was passed through the lock while repairing the sluice, so that no delay to navigation on the canal occurred.

On the 26th of June a serious sink hole occurred in the bottom of the Glens Falls feeder, about a mile and a half above Sandy Hill; the water had to be drawn off, and navigation on the feeder was delayed one day, but no particular delay occurred on the canal.

On the 7th of July the lower gates of Moses Kill lock were carried out by a boat, which delayed navigation three days, as there were no gates on hand, and new ones had to be built.

On the 9th of July the new bulkhead built to the sluice around lock No. 5 on the Glens Falls feeder, at the time of the break on the 11th of May, became undermined so that the whole had settled down about four feet. The water had to be drawn off from the feeder until a temporary dam could be built around the bulkhead. The water was then passed through the lock to supply the canal. Navigation on the canal was delayed one day, and on the feeder three days. This trouble arose in consequence of the sandy character of the materials of which the bank was composed, and the use of shorter sheet piling in front of the work than had been

directed by the engineer. The break was promptly repaired by the repair contractor.

IMPROVEMENT OF CHAMPLAIN CANAL.

Act chapter 186, Laws of 1864, authorized the "improvement of the navigation of the Champlain canal and Glens Falls feeder in such manner as to give in the entire length of each a depth of five feet of water, and a uniform width of thirty-five feet on the bottom, as near as it can be judiciously done in the opinion of the Canal Board, and to complete the work of stopping the leaks on the Glens Falls feeder.

A survey and estimate of the cost of this work were made in the fall of 1864. The aggregate of the estimated cost was \$535,000. The law above referred to appropriated the sum of \$295,000. Act chapter 156 Laws of 1866 made a further appropriation of \$247,500 for the completion of the work.

In the month of December, 1864, the Canal Commissioners placed under contract certain portions of the improvement which were considered of the most importance. This work was embraced in seven contracts, all of which have been completed at an aggregate cost of \$53,144.21.

In the month of November, 1865, a further amount of work was placed under contract, amounting at contract prices to the sum of \$130,000. This was all commenced during the past winter, but owing to the scarcity of laborers less work was done than was contemplated, yet enough was completed to show what effect the improvement was to have on the navigation of the canal.

During the winter and spring of 1865 and 1866, a considerable amount of work which had not been put under contract, was done by the superintendents of repairs and repair contractors.

The improvement of the canal and feeder is now all under contract, with the exception of raising a part of towing path on Wood creek. This last work is not absolutely necessary to obtain the required dimensions, but is important for putting the towing path in good condition, and making this part of the canal navigable in times of freshet, when the water is from two to four feet higher than the ordinary level. The contracts require all the work to be completed by the 1st of May, 1867. It is doubtful whether this can be done, but it is confidently believed that by the stipulated time the prism of the canal can be made of the required dimensions, so as to have the full benefit of the width and depth, leaving

the bridges which are to be rebuilt, and the putting in of the docking on top of the towing path, to be completed during the summer.

The Canal Board have directed the rebuilding of the Moses Kill lock of the enlarged size required by the constitution, as amended in 1854, and have provided that the amount of the cost over and above that of rebuilding on the present plan, be paid from the fund for the improvement of the Champlain canal, under acts chap. 186 Laws of 1864, and chap. 156 Laws of 1866. The estimated difference in cost is \$21,300, which amount is appropriated from the above fund, the lock being put under contract at prices which in the aggregate equal \$48,790, the amount of the estimate.

This \$21,300 for the lock, added to the amount for other work under contract, uses up the entire appropriation, with the exception of \$15,601.52 which will be required for engineering and miscellaneous expenses.

The account of the work and the fund appropriated for it will then stand as follows:

| | |
|---|--------------|
| Expended by superintendent in 1864 | \$8,268 27 |
| do for engineering in 1864 and 1865 | 3,758 32 |
| Work done by superintendents in 1865 | 22,959 61 |
| do by repair contractors in 1865 | 10,066 33 |
| do on contracts in 1865 | 46,909 74 |
| do do 1866 | 94,965 87 |
| do by superintendents in 1866 | 39,617 39 |
| do by repair contractors in 1866 | 25,389 82 |
| Expended for engineering in 1866 | 10,030 12 |
| Miscellaneous expenses up to Sept. 30, 1866..... | 289 40 |
| <hr/> | |
| Total amount expended to Sept. 30th 1866 | \$262,254 87 |
| Amount of work remaining to be done on canal and feeder now under contract | 243,343 61 |
| Appropriation for Moses Kill lock | 21,300 00 |
| <hr/> | |
| Total estimated cost of work done & under contract | \$526,898 48 |
| Appropriation by act chap. 186, Laws of 1864..... | \$295,000 00 |
| Appropriation by act chap. 156, Laws of 1866..... | 247,500 00 |
| <hr/> | |
| | \$542,500 00 |
| <hr/> | |
| Balance left for engineering and miscellaneous .. | \$15,601 62 |
| | <hr/> |

By act chap. 203, Laws of 1866, the location of the road bridge at Whitehall was changed, and a new bridge constructed at a cost of \$7,322.03, which was paid from the improvement fund as required by the act. This bridge was not included in the original estimates for the improvement, but as the appropriations by the two acts of the Legislature exceed the original estimated expense, the cost of the bridge is added to the amount in the preceeding statement.

BLACK RIVER CANAL.

ORDINARY REPAIRS.

The repair contract for section No. 1 of this canal expired on the 1st day of January, and that for section No. 2 on the 1st day of March, 1866. These contracts were re-let on the 28th day of March, to take effect on the 1st day of April.

Section No. 1 extends from the Erie canal at Rome to a point 1,000 feet north of lock No. 70, and has on it 59 single and 11 combined locks, with 264 gates in all. This part of the canal had been in use 16 years previous to the letting of the present repair contract.

Since 1860 there had been 66 new lock gates put in, and there remained 198 old ones which had never been renewed. As a matter of course these gates were in a very bad condition, and in the month of February the Commissioner directed the superintendent to procure a large amount of timber, there being on hand at that time only enough for about 30 gates. This was accordingly done, and a large force of men set to work removing old and framing and putting in new gates, so that on the 1st of April, when the new contractors took possession of the work, there had been 86 gates taken out and 34 inserted, and enough of timber delivered and contracted to be delivered for about 70 more. The contractor was required to take all the timber and other materials on hand, and all that were contracted to be delivered, and allow cost prices therefor; also to continue the same force which was engaged on the work the day of his taking possession, to pay the expenses of the same from that date, and to cause at least 75 new gates to be finished before the opening of navigation. These requirements were faithfully performed by the contractor, and on the 1st day of May, the time of opening, there had been inserted 86 gates, including those put in by the superintendent.

The sluices around the locks, and the docking at the head were

in a very dilapidated condition, as were also very many of the bridges. The superintendent had procured the timber for several bridges, and commenced framing the same.

Since the opening of navigation the contractor has put in five lock gates, built and repaired a large number of bridges, and made extensive repairs on the sluices around the locks.

Section No. 2 includes the canal from 1,000 feet north of lock No. 70 to its entrance into the Black river below Lyons Falls, together with the Black River feeder. When the new repair contract took effect, the feeder had been in use for 17 years, and the canal north of Boonville from 12 to 14 years. The former at several points required to be extensively bottomed out, and the lower gates of the guard lock to be renewed.

The canal and locks were in fair order, although it was necessary to replace some of the gates and to repair a part of the sluices and the docking at the head of the locks. A number of the bridges had been rebuilt, and were generally in a very good condition.

A small part of the necessary work has been done, but as the contracts for sections 1 and 2 are essentially in the hands of the same parties, more particular attention has been given to section No. 1.

Section No. 3 includes the Black River improvement from Lyons Falls to Carthage, a distance of $42\frac{1}{2}$ miles. On this part of the river there are five bridges, two dams and one lock. There are also two houses for bridge tenders and one for lock tenders. Four of the bridges have draws in them, which have to be operated by the contractor. Two of the bridges, viz: Beach's and Illingworth's, with the exception of the draws, belong to the towns in which they are located. By act, chapter 602, Laws of 1866, the Canal Commissioner in charge is required to repair and maintain the last two bridges, the expenses being paid from the ordinary repair fund, provided the Canal Board deem it for the interest of the State to maintain them.

The general repairs of this river, aside from the mechanical structures, consist in keeping a channel dredged out, to the depth of five feet at low water, for the entire distance. During the past summer the water in the river has not been at its lowest stage, and but little trouble has been experienced in keeping up good navigation.

IMPROVEMENT OF BLACK RIVER.

The construction of the lock and dam about three miles above Beach's bridge, was put under contract in 1865 and has progressed slowly during the year. The materials are generally all delivered, but owing to the high stage of water during the greater part of the season the completion of the work cannot reasonably be expected. The foundation of the lock is in, the side walls are carried up about eight feet, and the vertical walls at the head and foot are partially constructed. The lock, together with the canal above and below, will be completed during the winter, and the dam put in early next spring, so as to secure to navigation the full benefit of the structure during the latter part of the season.

EXTRAORDINARY REPAIRS.

Under this head no work has been done on this canal. The pier at Otter creek lock, authorized by the Canal Board in 1863, has not been built, though some of the materials have been delivered. This work should be completed this winter, in order to prevent the high freshet of Otter creek from washing across the foot of the lock and forming the bar which generally deposits there in the spring.

IMPROVEMENT OF ALBANY BASIN.

By act chapter 503, Laws of 1866, the Contracting Board, under the direction of the Canal Board, were authorized "to improve the Albany basin, as proposed and laid down in a map accompanying the report of the State Engineer and Surveyor, to the Legislature, for the year 1865, entitled 'Map of Albany Basin,' or upon such modifications and change of said plan, so far as it relates to the contraction of said basin, as the Canal Board may determine."

The Canal Board adopted the plan of enlarging the openings at the north and south ends of the basin, as follows: At the south end by cutting off the lower end of the pier to a point, about fifteen feet north of Hamilton street bridge, and removing said bridge and the pier on which it rests, and dredging to a depth of ten feet below ordinary low tide the whole channel, from the lower end of the pier to the upper side of the bridge. At the north end, by cutting off the upper end of the pier about 175 feet on the basin side and 110 feet on the river, by cutting off the point of land on the shore side above, in a triangular form, sixty feet on the basin line, filling up the basin on the shore side for about 210 feet,

so as to make it conform to the line cut off from the point above, and protecting both shore and upper end of pier by a heavy docking placed upon cribs and piles, the parts cut off being dredged to a depth of the mitre sill of lock No. 1, or eight feet below ordinary low tide. This work was put under contract on the 22d of May, to be completed by the 1st of September. Owing to the various constructions of the act which authorized this work, as to whether the city or State was to pay the damages which would accrue, the work was delayed, and at one time ordered suspended by the Canal Board. The work cannot be completed before the last of November and perhaps not at that time, as high water in the river is now, October 1st, very much retarding the progress of the work. The amount of work done up to this date is \$19,960. No action has been taken by the Canal Board with reference to the other improvement specified in the act.

The following special laws, relative to the canals on this division, were passed by the Legislature during its last session:

Act chapter 493, Laws of 1866, authorized the Canal Board "to construct, or cause to be constructed and maintained at the expense of the State, a suitable highway bridge over the navigable waters of Black River improvement, now used as a State canal, between the towns of Denmark and Croghan, at Parker's Ferry, in the county of Lewis, at a point to be designated by said board (if in the opinion of said Board the State ought to build said bridge), to be paid from any money appropriated for ordinary or extraordinary repairs of the canals, the cost not to exceed \$7,000."

On the 12th of June an estimate of the cost of constructing a suitable bridge at this point, amounting to \$18,400, was made and presented to the Canal Board, on which they passed the following resolution:

Resolved, "That the Canal Board having ascertained by the report of the Division Engineer of the eastern division that the sum of \$7,000 appropriated to build a road bridge across the Black river, between the towns of Denmark and Croghan, in the county of Lewis, by act chap. 493, Laws of 1866, passed April 10th, 1866, is insufficient for that purpose by the amount of at least \$11,400, deem it not necessary to inquire into the obligation of the State to build said bridge, and they, therefore, for the reason above stated, decline to authorize the building of the same."

Act chapter 618, Laws of 1866, authorized "the Canal Commissioner in charge of the eastern division to cause to be constructed and maintained a substantial public road bridge over the Erie canal, in the east part of the village of Ilion, to be paid for from the fund appropriated for extraordinary repairs on the eastern division." Nothing has been done to this bridge for the reason that all the appropriations for extraordinary repairs were made for a specific object under act chapter 219, Laws of 1866, and there was no money with which to build this bridge.

Act chapter 668, Laws of 1866, authorized "the Canal Commissioners to construct and maintain, at the expense of the State, a suitable highway bridge over the Champlain canal at Saratoga street, in the village of Schuylerville." No action has as yet been taken by the commissioners relative to this bridge.

Act chapter 807, Laws of 1866, authorized the construction of an iron bridge over the Erie canal at Columbia street, Cohoes, in the place of the old wood bridge which had fallen down. The bridge, however, was rebuilt of wood, as there was none of the extraordinary repair fund on hand, and the appropriations for ordinary repairs prohibited any of the money to be used for a change of plan.

Act chapter 875, Laws of 1866, authorized the Canal Commissioners to open the covered stone drain along the berme bank of the Erie canal, from north side of Earl street in the village of West Troy to the next culvert south of said street, or to construct a new drain along the west side of the McAdam turnpike, from Earl street to the said culvert, if in the opinion of said Commissioners, the construction of the new drain would be for the best interests of the State, the work not to cost or exceed \$500. "No work has been done on the same, as the law does not make an appropriation of the money from any particular fund," and also specifies "the drain along the berme bank of the canal," when in reality the only drain at this point is on the tow-path side.

Section 2 of act chapter 791, Laws of 1866, appropriating money for the maintenance of the canals, provides that "no part of the money appropriated by this act shall be paid for repairs done on what is called a change of plan, unless the same be authorized by the Canal Board, by an affirmative vote of at least five members."

Act chapter 657, Laws of 1866, authorizes and requires "the Canal Commissioners to remove or cause to be removed from the

land taken by the State for canal purposes, except those parts thereof which lie in thickly built parts of cities, all encroachments thereon, whether in the shape of buildings, fences or other structures, except dry docks, authorized by the Canal Commissioners, or manufactories, mills or warehouses doing business upon the canal, that said lands may be kept in the possession of the State for the purposes of canal navigation."

By act, chap. 352, Laws of 1866, "the location of a farm bridge over the enlarged Erie canal, on the farm of Nathaniel Hulser, in the town of Frankfort, county of Herkimer, which had been maintained by the State since the said enlargement, is hereby declared valid and of full effect, the same as if the said location had been approved by the Canal Board, and entered upon the enlargement maps of said canal; and the State Engineer and Surveyor is hereby directed to enter the said designation and location of the aforesaid bridge upon the enlargement maps."

Act chap. 354, Laws of 1862, imposes a penalty of \$15.00 on every person who shall lead, ride or drive, any horse or horses, mule or mules, or shall drive any cattle across any bridge or bridges belonging to or under the control of the State, faster than upon a walk, and restricts the number of cattle allowed on any bridge, at one time, to twenty-five. This law now remains as a dead letter, and the bridges over the canals are very seriously injured in consequence of its violation. It is recommended that the superintendents and repair contractors be especially required to see to it, that this law is rigidly enforced.

GENERAL IMPROVEMENTS REQUIRED.

ERIE CANAL.

The canal between the two side cuts at West Troy, a distance of about one mile, should be improved by removing the old wall benches and slope wall, and constructing a vertical wall or docking on both sides where it has not already been done. The shape of the canal renders it very difficult for boats to pass down and enter the Hudson river at the lower side cut, the sides of the banks being in such shape that boats cannot approach within 14 feet of either bank. At many points, lumber yards and manufac-

tories are located, where large amounts of freight have to be unloaded on both sides of the canal, and it is frequently difficult for boats to pass while others are unloading. When there is any thing out of repair, as is often the case in the locks on the upper side cut which has only a single tier of locks, all boats have to run to the lower side cut in order to get into the Hudson river. Very much delay is occasioned at such times by the narrowness of the canal; and when boats get down near the side cut they cannot be moved, there being no dock to tie up to, while they are waiting for other boats to pass the locks. This trouble and delay is many times very serious for those navigating the canals, and can only be remedied by the plan of enlarging proposed above.

I am of the opinion that another lock should be built at lock No. 2, to complete the line of double locks on this division, and that another tier of locks should be built on the upper side cut at West Troy. This would very materially facilitate the passage of boats at the terminus of the canal where all boats from all the canals bound for tide water have to come, except those from the Champlain canal, which pass into the Hudson river at the Waterford side cut. Acts, chaps. 354 and 355, Laws of 1864, authorized the construction of these locks, but did not provide funds that were available for the same.

There are very many portions of this canal which still retain the wall benches and slope wall on the original plan for the enlargement, adopted when this work was first commenced in 1836 or 1837.

These, on this division, altogether, amount to 69 miles, or about one-half the division, and are as follows:

| | Miles. |
|---|--------|
| From lock No. 2 to West Troy side cut | 4.30 |
| “ “ 3 to lock No. 18 | 3.30 |
| “ “ 18 to Schenectady | 13.40 |
| “ “ 23 to Fultonville | 5.80 |
| “ Spraker's to Little Falls..... | 18.30 |
| “ Little Falls to Utica | 21.40 |
| “ Newville to Wood creek, through Rome..... | 2.50 |
| | <hr/> |
| Total | 69.00 |
| | <hr/> |

The plan on which this canal was built was only 42 feet wide on the bottom, with slopes and offsets on each side, making a width of 70 feet at the surface of water, and a depth of seven feet. Experience demonstrated this plan was not such as was best calculated to facilitate navigation, and it was subsequently changed so as to give a width of $52\frac{1}{2}$ feet on bottom, with sides faced with slope wall, laid on a slope of $1\frac{1}{4}$ to 1. This was again changed for one 56 feet wide on bottom, with side slopes of 1 to 1, and with the surface 70 feet wide as before. This last plan is now considered, practically, the best form to facilitate navigation, and it is recommended that all the canal be improved and made to conform to it except through cities and important villages where vertical walls should be adopted, as far as may be necessary, to accommodate business. The importance of this improvement is rendered greater in consequence of its being generally located east of the entrance of the lateral canals, where a larger number of boats are passing than on any other part of the canal.

A vertical wall is required on the berme side of the canal between Big Basin and Clay street, in the eastern part of the city of Utica, at the point heretofore referred to as having had the wall bench and slope of bank excavated by a dredge. In 1862, a vertical wall was built on the towing-path side for most of this distance, and since that time it has been used for a dock by the New York Central Railroad Company, on which to land or deliver wood and other supplies for their road, and boats are constantly lying there discharging their cargoes. Nothing was done at that time to improve the berme side of the canal, and it has been with the greatest difficulty that two loaded boats could pass outside of the boats lying at the dock, and frequent jams occur which delay navigation. To improve this point the dredging has been done, and this renders necessary the protection of the bank by a vertical wall.

There has been no trouble through the want of a sufficient supply of water on this canal during the year. The streams from which the supply is obtained, have not run down to the extreme low water mark. Very little water has been drawn from the three reservoirs at the head waters of Black river, and they are all now nearly full, which almost warrants a supply for another year. In the month of June the drought was severe, and it was feared that the supply would be short, as the reservoirs were not full, and it

was necessary to draw from them for a short time, but since then all has been right and the water has been abundant.

The question of the supply of water for this canal is one of very great importance, and I would respectfully refer you to my views as stated in my last annual report to the State Engineer and Surveyor.

CHAMPLAIN CANAL.

In carrying out the law of 1864, very many of the necessary improvements on this canal are being made, but there are several important matters which cannot be reached under this law.

The locks from Waterford to Fort Edward have no sluices around them, in which to pass the water required to supply the different portions of the canal, and the feeding has all to be done through the locks. Provision should be made for constructing permanent sluices around each lock as early as practicable.

On the Glens Falls feeder the sluices around the locks were originally constructed by an arch culvert extending from the bulkhead to near the foot of lock, and covered over with earth. This arch has, in every instance, failed, the foundation plank being laid lengthwise has been forced up, and the structure undermined by the action of the water carrying away the sandy material on which it rests. At a portion of the locks the arch has been abandoned and a new structure of wood built above it to conduct the water into the level below. There are three of the locks where the arch yet remains in use, but they are in bad condition, and wood structures should be put in during the ensuing winter, as much trouble is constantly occurring. The masonry of the guard lock at head of feeder is in a bad condition, and requires either to be rebuilt or extensively repaired.

There are on this canal three very important dams which will soon require rebuilding, as they are wooden structures and have stood since the canal was first built. One is across the Mohawk river at Cohoes, and is 1,590 feet long; the other two are across the Hudson river, one at Fort Miller bridge, 875 feet long, and the other at the head of Glens Falls feeder, 800 feet long. They are now in a dilapidated condition, and should be rebuilt of stone as soon as the means for so doing can be provided. The new dams will all have rock foundations, and can be located either above or below the old ones, so as to be constructed in the summer season

without interfering with navigation. I would recommend that an appropriation be made for these dams, and that they be constructed at an early day of such height as will apply to an enlarged canal. In my opinion, the time is not far distant when the wants of trade and commerce will require an enlargement of the prism of the canal, so as to make it conform to the size of the locks which have been rebuilt, and are of the same size as those on the Erie canal.

The tolls received on this canal exceed those of any in the State except the Erie, and are $20\frac{1}{2}$ per cent. more for the fiscal year 1866, than those of the Oswego canal. The tolls for 1866 are $16\frac{3}{4}$ per cent. more than they were in 1865, and 39 per cent. more than the average for the last ten years. The amount received during the fiscal year 1865, is \$154,523.60, and during 1866, \$180,515.15.

BLACK RIVER CANAL.

There are several points on this canal where the streams which are taken in are very troublesome, in consequence of the deposits brought in and the bars formed, so as to delay navigation until they can be removed. Some of these can at small expense, be turned off into other streams which pass under the canal. Others can be passed under the canal by constructing culverts, and others cannot be disposed of in any way except as now by receiving them into the canal.

There are several points along the Lansing Kill, where the channel of the stream is constantly changing and washing away the canal bank. To prevent this the bank requires to be protected by a rip rap wall. North of Boonville, there are several places where sink holes are formed by the water working down into crevices in the rock which lies underneath, and the water which should be turned south to supply the Erie canal is thus wasted. It will be necessary to repair these places at some future time by excavating the earth from above the rock, and filling up and covering the crevices with rubble masonry.

I would recommend that the dam across Black river at Lyons Falls, be raised one foot in the centre, leaving about fifty feet width next to each abutment of the present height, in order that the water which passes at ordinary times may be conducted to either side for the benefit of the hydraulic power. The Canal Appraisers inform me that the heavy damages which will have to be paid if

this is not done, will be entirely avoided if it is done. The estimated cost is \$1,200.

The Canal Board located the lock and dam now being constructed on Black River, about three miles above Beach's bridge. To improve all the bars in the river, it should have been located about five miles below, but this location would have created very extensive claims for damages, in consequence of the destruction of a large part of the interval land along the river between these two points by the overflowing of the water. For this reason the present location was made. Some other plan will have to be devised for the improvement of this part of the river, before complete navigation can be made. I have no doubt that it can be accomplished by constructing jetty dams and piers and dredging the channel, or perhaps by simply dredging the channel. It would assist navigation very much if flash boards, one foot high, were placed on the Carthage dam during low water, as this would probably raise the water at least four inches at Beach's bridge, there being only $1\frac{1}{2}$ feet fall between this place and Carthage when the river is at its lowest stage.

The channel for discharging the flood waters of the North Branch reservoir is not of sufficient capacity at all times, and the security of the work is sometimes endangered by the waters rising too high in the reservoir. It is very important that another channel be excavated of about 30 feet in width to aid in passing off the high water. Some improvements are also required to the fixtures of the valves to make them operate more easily. It is also important that roads to all the reservoirs be kept open, in order that it may be possible to get to them with teams and wagons if repairs should become necessary.

The man in charge of the reservoirs now lives five miles from North Branch, seven miles from South Branch, and eleven miles from Woodhull, for the reason that there is no house for him to live in at a nearer point. I would recommend that a good house of sufficient size for a small family be constructed at North Branch reservoir, expressly for this man to live in. If this is done he will be only two miles from South Branch and six miles from Woodhull.

No regular system has ever been adopted for reports relative to the condition of the water in these reservoirs until this season. The man in charge is now required to make weekly reports to the

Canal Commissioner and Division Engineer of the actual condition of each one. By this means the important facts relative to each reservoir are known every week, and in a few years a large fund of information will have been obtained, which will be of great service to the officers in charge of the canals.

Respectfully submitted,

DANIEL C. JENNE,

Division Engineer.

TABLE No. 1.

Showing the number and compensation of Engineers employed upon the Eastern Division of the New York State canals, together with incidental expenses, from October 1, 1865, to October 1, 1866.

REPAIRS—ERIE CANAL.

| NAMES. | RANK. | Number of days. | Rate of compensation. | Amounts. | Totals. |
|-----------------------------|-------------------------------|-----------------|-----------------------|----------|------------|
| Daniel C. Jenne..... | Division engineer..... | ----- | \$2,000 00 | \$950 00 | |
| Daniel C. Jenne..... | Travel..... | ----- | ----- | 188 88 | |
| Oscar L. Wetmore..... | Resident engineer..... | ----- | 1,700 00 | 615 00 | |
| Oscar L. Wetmore..... | Travel..... | ----- | ----- | 103 60 | |
| D. Judson Jenne..... | Assistant..... | 30 | 4 50 | 135 00 | |
| D. Judson Jenne..... | Assistant..... | 58 | 5 00 | 290 00 | |
| Edward H. Ball..... | Assistant..... | 25 | 3 50 | 87 50 | |
| Edward H. Ball..... | Assistant..... | 50 | 4 00 | 200 00 | |
| William B. Cooper..... | Assistant..... | 20 | 5 00 | 100 00 | |
| M. H. Roberts..... | Surveyor and draughtsman..... | 15 | 3 50 | 52 50 | |
| John A. Cooper..... | Draughtsman..... | 18 | 5 00 | 90 00 | |
| Roselle N. Jenne..... | Assistant in office..... | 69 | 3 00 | 207 00 | |
| James D. Hancock..... | Inspector..... | 8 | 4 00 | 32 00 | |
| <i>Incidental Expenses.</i> | | | | | \$3,051 48 |
| Stationery..... | ----- | ----- | ----- | \$156 55 | |
| Postage and telegraph..... | ----- | ----- | ----- | 78 79 | |

| | | | | | |
|-------------------------------|-------------------------|------------|--|----------|------------|
| [Assem. No. | Miscellaneous | | | 73 40 | 308 74 |
| | Total Erie canal | | | | \$3,360 22 |
| CHAMPLAIN CANAL. | | | | | |
| 22 Daniel C. Jenne | Division engineer | \$2,000 00 | | \$800 00 | |
| 23 Daniel C. Jenne | Travel | | | 165 52 | |
| Oscar L. Wetmore | Resident engineer | 1,700 00 | | 555 00 | |
| Oscar L. Wetmore | Travel | | | 78 28 | \$1,598 80 |
| Total Champlain canal | | | | | \$1,598 80 |
| BLACK RIVER CANAL. | | | | | |
| Daniel C. Jenne | Division engineer | \$2,000 00 | | \$250 00 | |
| Daniel C. Jenne | Travel | | | 45 60 | |
| Oscar L. Wetmore | Resident engineer | 1,700 00 | | 530 00 | |
| Oscar L. Wetmore | Travel | | | 203 76 | \$1,029 36 |
| Incidental Expenses. | | | | | |
| Postage and telegraph | | | | 22 11 | |
| Miscellaneous | | | | 3 00 | 25 11 |
| Total Black River canal | | | | | \$1,054 47 |

TABLE No. 1—Continued.
IMPROVEMENT CHAMPLAIN CANAL.

| NAMES. | RANK. | Number of days. | Rate of compensa- tion. | Amounts. | Totals. |
|--------------------|-----------------------|--------------------|----------------------------|----------|---------|
| Geo. M. Barnes | Assistant | 151 | \$5 00 | \$755 00 | |
| William H. Printup | Assistant | 9 | 4 50 | 40 50 | |
| William H. Printup | Assistant | 130 | 5 00 | 650 00 | |
| William H. Printup | Assistant | 104 | 5 50 | 572 00 | |
| Julius A. Watkins | Assistant | 156 | 4 00 | 624 00 | |
| Julius A. Watkins | Assistant | 156 | 4 50 | 702 00 | |
| John A. Cooper | Draughtsman | 135 | 5 00 | 675 00 | |
| M. H. Roberts | Leveler | 51 | 3 50 | 178 50 | |
| M. H. Roberts | Assistant | 156 | 4 00 | 624 00 | |
| D. Judson Jenne | Assistant in office | 28 | 4 50 | 126 00 | |
| D. Judson Jenne | Assistant in office | 99 | 5 00 | 495 00 | |
| Edward H. Ball | Assistant and leveler | 36 | 3 50 | 126 00 | |
| Edward H. Ball | Assistant and leveler | 84 | 4 00 | 336 00 | |
| W. G. Bussey | Rodman | 6 | 2 50 | 15 00 | |
| M. E. McEntee | Rodman | 109 | 3 00 | 327 00 | |
| Charles E. Harris | Rodman | 156 | 3 00 | 468 00 | |
| Charles E. Harris | Axeman | 85 | 2 00 | 170 00 | |
| Walter Smith | Axeman | 67 | 2 00 | 134 00 | |
| Richard Smith | Axeman | 2 $\frac{3}{4}$ | 2 00 | 5 50 | |

| | | | | | |
|-----------------------------|-----------|-----|------|---------|-------------|
| Geo. P. Mulliken | Axeman | 10 | 2 00 | 20 00 | \$9,609 00 |
| David Denis | Axeman | 2 | 2 00 | 4 00 | |
| Arch. McLaughlin | Axeman | 12 | 2 00 | 24 00 | |
| A. J. Calkins | Axeman | 5 | 2 00 | 10 00 | |
| James Ray | Inspector | 249 | 4 00 | 996 00 | |
| D. C. Holeman | Inspector | 65 | 3 50 | 227 50 | |
| William H. Smith | Inspector | 165 | 3 50 | 577 50 | |
| Charles D. Nichols | Inspector | 42 | 3 00 | 126 00 | |
| Gideon Curswell | Inspector | 18 | 3 50 | 63 00 | |
| Rufus Gardner | Inspector | 150 | 3 00 | 450 00 | |
| Hiram Parker | Inspector | 25 | 3 50 | 87 50 | |
| <i>Incidental Expenses.</i> | | | | | |
| Postage and telegraph | | | | \$73 94 | |
| Stationery | | | | 175 33 | |
| Miscellaneous | | | | 171 85 | 421 12 |
| Total improvem't Champlain, | | | | | \$10,030 12 |

LOCK AND DAM ON BLACK RIVER.

| | | | | |
|-----------------|---------------------|-----|--------|---------|
| D. Judson Jenne | Assistant in office | 5 | \$4 50 | \$22 50 |
| D. Judson Jenne | Assistant in office | 28 | 5 00 | 140 00 |
| Geo. B. Beach | Assistant | 13 | 3 50 | 45 50 |
| Geo. B. Beach | Assistant | 150 | 4 00 | 600 00 |
| M. H. Roberts | Draughtsman | 12 | 3 50 | 42 00 |

TABLE No. 1—LOCK AND DAM ON BLACK RIVER—(Continued).

| NAMES. | RANK. | Number of days. | Rate of compensa- tion. | Amounts. | Totals. |
|-----------------------------|-------------------|--------------------|----------------------------|----------|------------|
| John A. Cooper..... | Draughtsman | 21 | \$5 00 | \$105 00 | \$1,014 50 |
| Chester Ray..... | Inspector..... | 17 | 3 50 | 59 50 | |
| Total lock and dam..... | | | | | 1,014 50 |
| REMOVING BENCHES AT ALBANY. | | | | | |
| D. Judson Jenne | Assistant | 5 | 4 50 | 22 50 | \$375 00 |
| D. Judson Jenne | Assistant | 28 | 5 00 | 140 00 | |
| Edward H. Ball | Assistant | 3 | 3 50 | 10 50 | |
| Edward H. Ball | Assistant | 46 | 4 00 | 184 00 | |
| George M. Barnes | Assistant | 4 | 4 50 | 18 00 | |
| Total removing benches..... | | | | | \$375 00 |
| DAM AT REXFORD FLATS. | | | | | |
| George M. Barnes..... | Assistant | 13 | 4 50 | 58 50 | \$375 00 |
| D. Judson Jenne | Assistant | 10 | 4 50 | 45 00 | |
| D. Judson Jenne | Assistant | 6 | 5 00 | 30 00 | |
| Edward H. Ball | Assistant | 14 | 3 50 | 49 00 | |
| Edward H. Ball | Assistant | 6 | 4 00 | 24 00 | |

| | | | | | |
|------------------------------|-------------|----|------|--------|----------|
| Wm. B. Cooper | Assistant | 14 | 5 00 | 70 00 | |
| James Ray | Inspector | 63 | 4 00 | 252 00 | |
| John A. Cooper | Draughtsman | 3 | 5 00 | 15 00 | |
| C. W. Rexford | Inspector | 52 | 3 50 | 182 00 | \$725 50 |
| Total dam at Rexford Flats | | | | | \$725 50 |
| CONCRETING LOCKS. | | | | | |
| D. J. Jenne | Assistant | 12 | 5 00 | 60 00 | |
| Total concreting locks | | | | | \$60 00 |
| WHITE STREET BRIDGE, COHOES. | | | | | |
| Dana Reed | Inspector | 75 | 4 00 | 300 00 | |
| Total White street bridge | | | | | \$300 00 |
| IMPROVEMENT OF ALBANY BASIN. | | | | | |
| Wm. B. Cooper | Assistant | 40 | 5 00 | 200 00 | |
| D. Judson Jenne | Assistant | 15 | 5 00 | 75 00 | |
| Edward H. Ball | Assistant | 48 | 4 00 | 192 00 | |
| John A. Cooper | Draughtsman | 6 | 5 00 | 30 00 | |
| David Gardner | Tapeman | 2 | 1 50 | 3 00 | |
| James D. Hancock | Inspector | 41 | 4 00 | 164 00 | |
| L. M. Clement | Inspector | 21 | 4 00 | 84 00 | |
| Total improv't Albany basin | | | | | \$748 00 |
| | | | | | \$748 00 |

SUMMARY OF TABLE No. 1,
Showing engineering expenses for fiscal year.

| NAME OF CANAL. | Engineering proper. | Incidental expenses. | Amounts. | Totals. |
|---|---------------------|----------------------|-------------|--------------|
| Repairs of the Erie..... | \$3,051 48 | \$308 74 | \$3,360 22 | } \$6,013 49 |
| do Champlain | 1,598 80 | ----- | 1,598 80 | |
| do Black River | 1,029 36 | 25 11 | 1,034 47 | |
| Improvement of Champlain | 9,609 00 | 421 12 | 10,030 12 | 10,030 12 |
| Lock and dam on Black River..... | 1,014 50 | ----- | 1,014 50 | 1,014 50 |
| Extraordinary repairs of the Erie..... | 1,160 50 | ----- | 1,160 50 | 1,160 50 |
| Ordinary repairs paid by the Canal Commissioners..... | 300 00 | ----- | 300 00 | 300 00 |
| Improvement of Albany basin..... | 748 00 | ----- | 748 00 | 748 00 |
| Totals..... | \$18,511 64 | \$754 97 | \$19,266 61 | \$19,266 61 |

TABLE No. 2.

Statement showing the length in miles, number of structures, estimated cost at contract prices, amount of work done for the fiscal year ending September 30th, 1866, whole amount of work done, and work completed, or settled, with the characteristic detail of contracts existing upon the Eastern Division of the New York State canals during the fiscal year ending September 30th, 1866.

| Length in miles. | Number of structures. | CHARACTER OF WORK. | Estimated cost. | Amount done during the fiscal year ending Sept. 30, 1866. | Whole amount done. | Amount remaining to be done. |
|------------------|-----------------------|--|--|---|--|--|
| 1. | ----- | ERIE CANAL—EXTRAORDINARY REPAIRS. Work let by Canal Commissioners under act chapter 105, Laws of 1887: Removal of benches and slope-wall, and the construction of a vertical and slope wall between locks Nos. 1 and 2----- Allowance by Canal Board under act chapter 499, Laws of 1865----- 1 Stone dam across Mohawk river at Rexford Flats----- Allowance by Canal Board, under act chapter 491, Laws of 1865----- | \$29,475 34 23,133 28 23,000 00 23,000 00 | 5,795 34 5,973 28 5,710 00 5,710 00 | \$29,475 34 23,133 28 19,100 00 19,100 00 | Settled. do \$3,900 00 3,900 00 |
| | | Total ----- | \$98,608 62 | \$23,188 62 | \$90,808 62 | \$7,800 00 |

TABLE No. 2—Continued.

| Length in miles. | Number of structures. | CHARACTER OF WORK. | Estimated cost. | Amount done during the fiscal year ending Sept. 30, 1866. | Whole amount done. | Amount remaining to be done. |
|------------------|-----------------------|---|-----------------|---|--------------------|------------------------------|
| | | IMPROVEMENT CHAMPLAIN CANAL. | | | | |
| | | Work let by Canal Commissioners: | | | | |
| | 1 | Improvement at Basset's lock ----- | \$7,075 31 | \$5,075 31 | \$7,075 31 | Settled. |
| 2.28 | 1 | Sluice around guard lock, Saratoga dam ----- | 3,925 49 | 1,225 49 | 3,925 49 | do |
| 2.28 | 1 | Tree dam on Wood creek ----- | 19,445 07 | 6,425 07 | 19,445 07 | do |
| 4.6 | --- | Improvement of Waterford level ----- | 9,128 00 | 5,300 00 | 5,300 00 | \$3,828 00 |
| | --- | Improvement from first lock north of Waterford to Hewitt's lock ----- | 24,356 80 | ----- | ----- | 24,356 80 |
| 4.2 | --- | Improvement from Hewitt's lock to Becker's lock ----- | 21,181 00 | 480 00 | 480 00 | 20,701 00 |
| 4. | --- | Improvement of section No. 1, of 16 mile level, do ----- | 20,445 00 | 12,540 00 | 12,540 00 | 7,905 00 |
| 4. | --- | do do No. 2, do ----- | 17,678 00 | 7,420 00 | 7,420 00 | 10,258 00 |
| 3.78 | --- | do do No. 3, do ----- | 15,387 00 | 7,500 00 | 7,500 00 | 7,887 00 |
| 4.22 | --- | do do No. 4, do ----- | 24,371 00 | 6,920 00 | 6,920 00 | 17,451 00 |
| 2.6 | --- | Improvement from Saratoga lock to Fort Miller lock ----- | 18,924 00 | ----- | ----- | 18,924 00 |
| 2.65 | --- | Improvement from Fort Miller lock to Moses Kill lock ----- | 16,401 60 | 340 00 | 340 00 | 16,061 60 |
| 5.50 | --- | Improvement from Moses kill lock to Fort Edward lock ----- | 22,038 00 | 720 00 | 720 00 | 31,318 00 |

| | | | | | |
|------|---|--------------|-------------|--------------|--------------|
| 4. | Improvement of section No. 1, of 12 mile level, | 13,456 50 | 4,500 00 | 4,500 00 | 8,956 50 |
| 4.08 | do do No. 2, do | 18,046 00 | 1,200 00 | 1,200 00 | 16,846 00 |
| 3.50 | do do No. 3, do | 15,883 00 | 2,980 00 | 2,980 00 | 12,903 00 |
| 1.38 | Raising towing path on Wood creek | 16,235 50 | 8,980 00 | 8,980 00 | 7,255 50 |
| | Stone dam on Wood creek | 7,077 50 | 6,200 00 | 6,200 00 | 877 50 |
| 5.50 | Improvement of Whitehall level | 35,850 00 | 16,500 00 | 16,500 00 | 19,350 00 |
| 7. | Improvement of Glens Falls feeder | 17,586 50 | ----- | ----- | 17,586 50 |
| | Rebuilding Moses Kill lock (difference between present size and enlarged lock). | | | | |
| | Total | 21,300 00 | 660 00 | 660 00 | 20,640 00 |
| | Total | \$375,791 27 | \$94,965 87 | \$112,685 87 | \$263,105 40 |
| | IMPROVEMENT OF BLACK RIVER. | | | | |
| 1 | Lock and dam above Beach's bridge | \$58,000 00 | \$17,820 00 | \$17,820 00 | 40,180 00 |
| 1 | Improvement of Albany Basin | \$40,000 00 | \$19,960 00 | \$19,960 00 | \$20,040 00 |

TABLE No. 3.

Statement showing amount of work done under the supervision of the Engineer Department, on repairs under contract, extraordinary repairs and miscellaneous repairs, upon the Eastern Division of the New York State canals, for the fiscal year ending September 30th, 1866.

| CHARACTER OF WORK. | Estimated cost. | Am't done in fiscal year ending Sep. 30, 1866. | Whole amount done. | Am't remaining to be done. |
|--|-----------------|--|--------------------|----------------------------|
| ERIE CANAL—ORDINARY REPAIRS (under contract). | | | | |
| Abutments and approaches White street bridge, Cohoes | \$11,788 00 | \$8,140 00 | \$8,140 00 | \$3,648 00 |
| Iron superstructure White street bridge, Cohoes | 6,612 00 | ----- | ----- | 6,612 00 |
| Total | \$18,400 00 | \$8,140 00 | \$8,140 00 | \$10,260 00 |
| EXTRAORDINARY REPAIRS. | | | | |
| Concreting lock No. 1 (1865, \$3,756.34) | \$9,126 22 | \$5,369 88 | \$9,126 22 | Settled. |
| do 4 | 2,924 22 | 2,924 22 | 2,924 22 | do |
| do 7 | 2,456 48 | 2,456 48 | 2,456 48 | do |
| do 14 | 2,593 12 | 2,593 12 | 2,593 12 | do |
| do 17 | 1,358 82 | 1,358 82 | 1,358 82 | do |
| do 20 | 1,392 86 | 1,392 86 | 1,392 86 | do |
| do 22 | 2,456 28 | 2,456 28 | 2,456 28 | do |
| do 23 | 1,383 90 | 1,383 90 | 1,383 90 | do |
| do 26 | 2,171 23 | 2,171 23 | 2,171 23 | do |

| | | | | |
|---|-------------|-------------|-------------|-------------|
| Removing wall bench and raising slope wall west of Castle creek----- | \$3,702 70 | \$3,702 70 | \$3,702 70 | do |
| Improving Rocky Rift feeder----- | 3,000 00 | 1,339 42 | 1,339 42 | \$1,660 58 |
| Excavating berme bank at City Mill, Utica----- | 640 00 | 640 00 | 640 00 | Settled. |
| Docking at Rome----- | 1,779 00 | 1,179 00 | 1,779 00 | do |
| Removing wall bench from Mohawk to Frankfort----- | 564 00 | 564 00 | 564 00 | do |
| Total----- | \$35,548 83 | \$30,131 91 | \$33,888 25 | \$1,660 58 |
| MISCELLANEOUS REPAIRS. | | | | |
| Repairs of piers and trunk of lower Mohawk aqueduct----- | \$5,150 94 | \$5,150 94 | \$5,150 94 | Settled. |
| Repairing berme bank and foundation of waste weir at Vischer's Ferry----- | 300 00 | 300 00 | 300 00 | do |
| New trunk to upper Mohawk aqueduct----- | 35,712 07 | 35,712 07 | 35,712 07 | do |
| Rebuilding docking for 1½ miles west of Schenectady----- | 48,000 00 | 36,874 61 | 36,874 61 | \$11,125 39 |
| Cutting channel through big basin at Utica in 1865----- | 190 00 | 190 00 | 190 00 | Settled. |
| Repairs of weigh lock and scales at Utica----- | 4,009 36 | 4,009 36 | 4,009 36 | do |
| Repairs of sidewalk to Genesee street bridge, Utica----- | 353 06 | 353 06 | 353 06 | do |
| Total----- | \$93,715 43 | \$82,590 04 | \$82,590 04 | \$11,125 39 |
| CHAMPLAIN CANAL—ORDINARY REPAIRS (under cont't). | | | | |
| Rebuilding Moses Kill lock, amount to be charged to ordinary repairs----- | \$27,490 00 | ----- | ----- | \$27,490 00 |

TABLE No. 3—Continued.

| CHARACTER OF WORK. | Estimated cost. | Am't done in fiscal year ending Sep. 30, 1866. | Whole amount done. | Am't remaining to be done. |
|---|-----------------|--|--------------------|----------------------------|
| MISCELLANEOUS REPAIRS. | | | | |
| Taking down and rebuilding two piers to the towing-path bridge across the Mohawk at Cohoes ----- | \$8,566 44 | \$4,259 94 | \$8,566 44 | Settled. |
| Taking up and relaying pier and putting in extra braces to Moses Kill aqueduct ----- | 258 64 | 258 64 | 258 64 | do |
| Total ----- | \$8,825 08 | \$4,518 58 | \$8,825 08 | |
| IMPROVEMENT CHAMPLAIN CANAL. | | | | |
| Improving canal from a point one and a quarter miles north of Hewett's lock, to basin at Mechanicsville ----- | \$5,840 00 | \$5,840 00 | \$5,840 00 | Settled. |
| Improving canal between first two bridges north of Moses Kill aqueduct. ----- | 4,531 83 | 4,531 83 | 4,531 83 | do |
| Improving Glens Falls feeder (deducted from appropriation for dredging) ----- | 5,250 00 | 5,250 00 | 5,250 00 | do |
| Improving Waterford side-cut ----- | 13,535 96 | 13,535 96 | 13,335 96 | do |
| Improving Haverland's waste weir ----- | 3,262 00 | 3,262 00 | 3,262 00 | do |
| Improving Haverland's bridge ----- | 5,375 00 | 5,375 00 | 5,375 00 | do |
| Improving Sherman's bridge ----- | 2,170 00 | 2,170 00 | 2,170 00 | do |
| Improving Fitzgerald's bridge ----- | 770 00 | 770 00 | 770 00 | do |

| | | | | |
|---|-------------|-------------|-------------|------------|
| Building road-bridge at Whitehall, under act chap. 203 Laws of 1866.----- | 7,322 03 | 7,322 08 | 7,322 03 | do |
| Completion of stopping leaks in Glens Falls feeder ----- | 3,040 00 | 3,040 00 | 3,040 00 | do |
| Completion of section No. 1 of stopping leaks in Glens Falls feeder (1865, \$11,194.61)----- | 22,530 00 | 11,335 39 | 22,530 00 | do |
| Rebuilding road-bridge at Glens Falls ----- | 3,875 00 | 875 00 | 3,875 00 | do |
| Work with dredge (1865, \$1,511.79) ----- | 4,750 00 | 1,700 00 | 3,211 79 | \$1,538 21 |
| Total ----- | \$82,251 82 | \$65,007 21 | \$80,713 61 | \$1,538 21 |

SUMMARY of Tables Nos. 2 and 3.

| NAME OF CANAL. | Estimated cost. | Amount done in fiscal year ending Sept. 30, 1866. | Whole amount done. | Amount remaining to be done. |
|---|-----------------|---|-----------------------|---------------------------------|
| Improvement Champlain canal, under contract | \$375,791 27 | \$94,965 87 | \$112,685 87 | \$263,105 40 |
| do do not under contract | 82,251 82 | 65,007 21 | 80,713 61 | 1,538 21 |
| Total | \$458,043 09 | \$159,973 08 | \$193,399 48 | \$264,643 61 |
| Extraordinary repairs, Erie canal, under contract | \$98,608 62 | \$23,188 62 | \$90,808 02 | \$7,800 00 |
| do do not under contract | 35,548 83 | 30,131 91 | 33,888 25 | 1,660 58 |
| do do Black R. canal, not under contract, | 6,500 00 | ----- | ----- | 6,500 00 |
| Total | \$140,657 45 | \$53,320 53 | \$124,696 87 | \$15,960 58 |
| Ordinary repairs, Erie canal, under contract | \$18,400 00 | \$8,140 00 | \$8,140 00 | \$10,260 00 |
| do do do not under contract | 93,715 43 | 82,590 04 | 82,590 04 | 11,125 39 |
| do do Champlain canal, under contract | 27,490 00 | ----- | ----- | 27,490 00 |
| do do do not under contract | 8,825 08 | 4,518 58 | 8,825 08 | ----- |
| Total | \$148,430 51 | \$95,248 62 | \$99,555 12 | \$48,875 39 |
| Improvement Black River, under contract | \$58,000 00 | \$17,820 00 | \$17,820 00 | \$40,180 00 |
| do Albany basin | 40,000 00 | 19,960 00 | 19,960 00 | 20,040 00 |
| Grand total | \$845,131 05 | \$346,322 23 | \$455,431 47 | \$389,699 58 |

TABLE No. 4.

Statement showing the number of sections, commencement and expiration of contract, name of contractor length in miles, amount per annum, and location of repair sections, under contract on the Eastern Division of the New York State canals on the 30th day of September, 1866.

| Number of section. | Commencement. | Expiration. | Name of contractor. | Length in miles. | Price per annum. |
|-------------------------|------------------|-----------------|---|------------------|------------------|
| ERIE CANAL. | | | | | |
| Section No. 1 | March 4, 1863-- | Dec. 4, 1866-- | Spencer Jackson | 19 | \$68,628 |
| Section No. 2 | Oct. 1, 1865-- | Jan. 1, 1869-- | Charles A. Donaldson | 32 | 17,740 |
| Section No. 3 | Oct. 1, 1864-- | Dec. 31, 1867-- | Van Slyck & Neff | 33 | 16,780 |
| Section No. 4 | Oct. 1, 1864-- | Dec. 31, 1867-- | Samuel F. Case | 24 | 22,900 |
| Section No. 5 | Oct. 1, 1864-- | Dec. 31, 1867-- | Edwin H. French | 34 | 12,000 |
| Total | | | | 142 | \$138,048 |
| CHAMPLAIN CANAL. | | | | | |
| Section No. 1 | Oct. 1, 1864-- | Dec. 31, 1867-- | Samuel G. Hart | 28 | \$25,800 |
| Section No. 2 | Oct. 1, 1864-- | Dec. 31, 1867-- | Charles B. Scott, assignee of Harvey Church | 24 | 19,400 |
| Section No. 3 | August 1, 1863-- | May 1, 1867-- | Henry D. Dennison | 22 | 12,000 |
| Total | | | | 74 | \$57,200 |

TABLE No. 4—Continued.

| Number of section. | Commencement. | Expiration. | Name of contractor. | Length in miles. | Price per annum. |
|--------------------|---------------|----------------|---------------------|------------------|------------------|
| BLACK RIVER CANAL. | | | | | |
| Section No. 1 | April 1, 1866 | Janu'y 1, 1870 | Wm. McArthur | 24 | \$16,440 |
| Section No. 2 | April 1, 1866 | Janu'y 1, 1870 | Arch. McArthur | 23 | 7,980 |
| Section No. 3 | March 1, 1865 | Janu'y 1, 1869 | Ward & McVickar | 42½ | 9,750 |
| Total | | | | 89½ | \$34,170 |
| Total for division | | | | 305½ | \$229,418 |

DESCRIPTION.

ERIE CANAL—Sec. 1. From Albany to north end of lower aqueduct, including Champlain canal to foot of guard lock, and the sloop lock and Troy dam.

Sec. 2. From north end of lower aqueduct to head of lock No. 27, including Rexford Flats dam and feeder.

Sec. 3. From head of lock No. 27, to foot of lock No. 34, including the Schoharie creek and Rocky Rift dams and feeders.

Sec. 4. From foot of lock No. 34, to head of lock No. 46, including the feeders and dams on both sides of Mohawk river at Little Falls.

Sec. 5. From head of lock No. 46, to Oneida Lake canal.

CHAMPLAIN CANAL—Sec. 1. From guard lock at Cohoes to foot of lock next north of Fort Miller bridge, including the Waterford side cut.

Sec. 2. From foot of lock next north of Fort Miller bridge to Dunham's basin, including Glens Falls feeder.

Sec. 3. From Dunham's basin to entrance into Lake Champlain at Whitehall.

BL'K RIVER CANAL—Sec. 1. From Rome to 1000 feet north of lock No. 70, including Delta feeder.

Sec. 2. From 1000 feet north of lock No. 70 to 300 feet north of lock No. 109, including Black River feeder, and N. Branch, S. Branch and Woodhull reservoir.

Sec. 3. From Lyons Falls to Carthage.

MIDDLE DIVISION.

DIVISION ENGINEER'S OFFICE, }
SYRACUSE, September 30th, 1866. }

HON. J. PLATT GOODSSELL, *State Engineer and Surveyor* :

In pursuance of the fifth regulation issued by the State Engineer and Surveyor, under act chapter 169, Laws of 1862, I have the honor to report for the fiscal year ending September 30, 1866, the number and compensation of all persons employed in the Engineer Department, and the extent and condition of the work pertaining to the Middle Division of the New York State canals, together with such suggestions and recommendations as I deem the best interests of the public service require.

The Middle Division, as now constituted, embraces the following completed canals, navigable feeders and river improvements, together with the reservoirs and feeders used for the supply of water, also the extension of the Chenango canal, which is now in process of construction, to wit:

| | Miles. |
|---|--------|
| Eric canal from east side of Oneida Lake canal to the east line of Wayne county | 68.58 |
| Oneida Lake canal | 6.00 |
| Oswego canal | 38.00 |
| Cayuga and Seneca canal | 22.77 |
| Crooked Lake canal | 8.00 |
| Chemung canal and feeder | 39.00 |
| Chenango canal | 97.00 |
| Oneida river improvement | 20.00 |
| Seneca river towing-path | 5.00 |
| Baldwinsville canal | 1.00 |
| Cayuga inlet | 2.00 |
| Limestone feeder | .80 |
| Butternut feeder | 1.55 |
| Camillus feeder | 1.00 |
| | 310.70 |
| | 310.70 |

Of which 155³⁵/₁₀₀ miles are navigable for boats of the largest class and the remainder for smaller ones.

Reservoirs—Erieville, Cazenovia lake, De Ruyter, Skaneateles lake, Madison brook, Woodman's pond, Leland's pond, Bradley brook, Eaton brook, Hatch's lake and Kingsley brook.

Feeders—Oneida creek, Cowassalon, Chittenango, Carpenter brook, Jordan, Weedsport and Port Byron, and the feeders connecting the several reservoirs with each other and with the canals.

Extension of the Chenango canal from the village of Binghamton to the Pennsylvania State line, 39.65 miles.

ENGINEER DEPARTMENT.

This department remained the same as preceding year up to the retiracy of J. Platt Goodsell, division engineer, on the 1st day of January. During the month of January the entire division was in charge of W. H. H. Gere, resident engineer, and from February 1st, to the close of the fiscal year, it was in charge of W. H. H. Gere, as division, and Howard Soule, jr., as resident engineers, with the exception of the extension of the Chenango canal, which has been under charge of Byron M. Hanks, as resident engineer, from the 15th of June last, appointed under act, chapter 794, Laws of 1866.

Table No. 1 exhibits the information required to be furnished in regard to the expenditures in this department upon all the canals.

From this table, and tables Nos. 2 and 3, I have prepared the following tabular statement, showing the whole amount of expenditures in the department, the amount of work done under supervision of the engineers, and the percentage of the cost of engineering upon the several canals of this division:

| Canals. | Engineering expenditures. | Amount of work done. | Percentage. |
|--------------------------|---------------------------|--------------------------|------------------|
| Erie | \$4,156 47 | \$40,520 88 | 10.25 |
| Oswego | 4,066 61 | 161,353 27 | 2.5 |
| Cayuga & Seneca | 549 80 | 2,509 36 | 21.9 |
| Crooked Lake | 241 08 | ----- | ---- |
| Chemung | 3,183 12 | 96,706 12 | 3.3 |
| Chenango (proper) | 2,396 11 | 50,853 09 | 4.7 |
| Chenango extension | 12,860 95 | 218,120 00 | 5.9 |
| | <hr/> \$27,454 14 <hr/> | <hr/> \$570,062 72 <hr/> | <hr/> 4.81 <hr/> |

It is proper to add in this connection that the engineer department, except upon the extension of the Chenango canal, has performed duties under the direction of the Canal Commissioner, viz: superintending ordinary repairs made by repair contractors which is included in and done under their respective contracts, and for which no other compensation is paid than the annual price in the contract.

If work of that character were included in the tables, the percentage of engineering would be greatly reduced from that exhibited in the foregoing statement. It will, however, compare favorably with any former year.

Table No. 2 exhibits a detailed statement of the work under contract for the fiscal year ending Sept. 30, 1866.

Table No. 3 is a detailed statement of the work not under contract, but authorized by Canal Board and under supervision of engineer department.

WORK UNDER CONTRACT.

ERIE CANAL.

The improvement of the Nine Mile Creek feeder, authorized by act, chapter 72, Laws of 1863, remains as reported last year. The appropriation having expired, nothing further can be done under the contract without legislative action.

There remains due on this contract, for work already done, the sum of \$194.26, and in order to complete the work as originally contemplated, will require a further sum of about \$2,000.

Temporary feeder at Port Byron.—The need of an additional feeder to supply the Port Byron level with water has long been felt, and the reports from this department in former years have urged the necessity of taking a portion of the Owasco creek for that purpose. During the last winter the fall of rain and snow was so slight that at the opening of navigation the water of Skeneateles lake was $2\frac{3}{4}$ feet below the top of the breast wall, and as that lake is the only reservoir, or the principal dependance for feeding that portion of the canal between lock No. 50 and Port Byron lock, great anxiety was felt as to how navigation could be maintained during the season.

In order to meet this question, the resident engineer was directed, early in April (after it was fairly settled that the lake could not fill), to make careful examinations and measurements, with a view of ascertaining whether or not the fears were well grounded. The

conclusion arrived at, proven by a careful computation of supply and demand, as contained in the report of the resident engineer, Howard Soule, jr., was "that unless we have an amount of rain "greatly above the average of the last twenty years, or a trade "materially diminished from that of 1864 during the present season, we shall be entirely short of water, and a consequent suspension of navigation, in a portion of the months of August and "September next." This fact was reported to the Canal Commissioners, and they on the 22d day of May contracted for the construction of a temporary conduit to connect the old mill race with the canal. The old race had not been in use for some years, and quite a large expenditure had to be made thereon. The work was completed in August last, and since that time has been in constant use, with no lack of water for the canal. The entire expense thereof was \$10,173.78.

Opening State ditch at Port Byron, required by act chap. 877, Laws of 1866, has been put under contract, and although nothing has as yet been done thereon, preparations are being made to commence at once.

Iron bridge at Grape street, Syracuse, authorized by act chap. 841, Laws of 1866, is under contract and in process of construction.

Improvement of Oneida creek feeder. Work under this contract was performed to the amount of \$2,260 last spring; the balance cannot be done until after the close of navigation. This improvement will make the Oneida creek contribute largely to the supply of the long level, which it could not do in its former condition.

OSWEGO CANAL.

Weigh lock at Oswego is completed, but the final account has not been made up. It is now being prepared by the assistant in charge of the work. The scale (one of Sampson & Tibbitt's) was inserted last spring, and works to the satisfaction of the officer in charge.

Phoenix dam. This structure is very nearly completed, and when done, being constructed of stone, will be permanent and reliable, requiring for the future little or no repairs. The policy adopted of rebuilding the dams upon the Oswego river of stone, and in a shape to control all the water of the river, is the only safe course to pursue; and the plans prepared for the other dams

are similar to the one upon which this is being constructed, varying only in detail to accommodate location.

Oswego Falls dam. The work upon this structure has progressed through the season, and is finished from the east end to the center of the river, and the coffer dam is now being constructed upon the west side. Should no unforeseen occurrence prevent, the whole work will be completed this fall.

Braddock's Rapids dam. There has been nothing done under this contract except the delivery of a portion of the required material.

It is expected that during another season this work will be pushed forward vigorously.

Berne bank, Oswego river. Under this contract a berme bank is being constructed of earth in the pond formed by Horse-shoe dam, and is, when completed, to supersede the dam.

It extends from the lock at Hinmanville to Horse-shoe dam lock, a distance of eighty-nine chains. The foundation for a dam being of a material upon which it is extremely hazardous to erect such a structure, the project of substituting for it an earth bank was adopted in 1865, and the work placed under contract; since which time progress has steadily been made in its construction, and from present indications the work must largely exceed the original estimate of its cost.

This increase results principally from the peculiar circumstances under which it has to be built.

The river bed in line of the bank is from eight to twenty-one feet in depth, and in depositing the earth into the water it spreads out much wider than was anticipated; besides, the current, which is strong, naturally carries with it a small portion of each boat load. That part of the bank in the deepest water is already built, and there can be no doubt that the remaining portion of the work will be finished with a far less percentage of loss of material, either by the spreading of the base of the bank, or in its washing away, the natural current being so much less in the shallow water, with the increased width of the river, as progress is made towards the old dam.

Another season will certainly be required to complete the work, but when done will entirely dispense with the Horse-shoe dam, the reconstruction of which would be the most difficult upon the river, for all the other dams are already or may be rebuilt upon a rock foundation.

High dam. This work is the completion of the repairs to the old wood dam, which was so badly injured by the freshet of March, 1865, and which was fully explained in reports of last year. The work was completed last fall, and the contract settled. The portion of this dam built across the breach is without doubt perfectly safe, but the old work is considered precarious notwithstanding it was as thoroughly repaired last season as possible without altogether reconstructing it.

When this dam is rebuilt its location should be changed to some point further down stream, where a rock foundation can be secured; this will require its removal only a short distance.

Bridge at Oswego, located near the weigh lock, and authorized to be built under act Chap. 611, Laws of 1866, has just been put under contract, but as yet nothing has been done upon it.

CHEMUNG CANAL.

Work in Chemung river at Corning. This work is very nearly completed. There remains some dredging in the river yet to be done, and in order to confine the river at all times to its proper channel, it will be necessary to construct a light guard bank from the lower end of the docking to the old guard bank. I would recommend that that work be done, and have included it in the estimated cost of the work.

In pursuance of act chap. 495, Laws of 1865, the Canal Board increased the prices contained in the contract for this work. Such increase on work done to the present time amounts to \$36,100.00.

The repairs or partial reconstruction of locks No's. 24, 25, 28 and 32, was thoroughly performed during the suspension of navigation last winter, leaving No's. 1, 36 and 40 of the old locks yet to be repaired or rebuilt. These are now under contract, and work upon them will be commenced at the close of navigation this season.

The locks upon this canal are all of the small class, and intended only for a canal of four feet depth of water, but since the adoption of a regulation by the Canal Board allowing boats to draw four feet of water, it has been necessary to maintain at least four and a half feet in the canal.

This has necessitated the raising of banks in some places, and more yet remains that should be done to render the banks absolutely secure. There is no difficulty in retaining the requisite $4\frac{1}{2}$ feet, except upon the lake level, and here the greatest obstruction

is the mitre sill of lock No. 1. The work of the enlargement of the Cayuga and Seneca canal, so increased the channel of Seneca river as to permit a greater flow of water from the lake, and a consequent reduction of its surface, so that during the dry season of the year there is scarcely four feet of water upon the lower mitre sill of lock No. 1. Especially is this the case during a strong south wind, which blows the water down the lake.

Considerable trouble from this cause has been experienced this season, and to obviate it, as well as for the better accommodation of the coal interest, in my judgment the foundation of that lock when it is rebuilt should be lowered. I would suggest that it be put down three feet lower, and that the bars in the prism between the lock and lake be removed, so as to secure seven feet of water.

The highway bridge over the Chemung canal feeder in the town of Corning, has been built under act chap. 168, Laws of 1865.

Selser swing bridge at Watkins, authorized by act chap. 519, Laws of 1866, has been put under contract, but nothing as yet done upon it. The present iron superstructure at that point is to be removed to Grape street, Syracuse.

CHENANGO CANAL.

Kingsley Brook reservoir.—This important work has progressed during the season with as much vigor as the assistance at hand would permit. The main bank forming the reservoir is nearly completed to the height fixed upon, and the dam at head of feeder as well as the feeder, is now well advanced. This work has been largely increased over the amount originally estimated, in consequence of raising the main bank higher than was contemplated. At first it was proposed only to repair the break in the bank and restore the feeder to its former condition, but it was found that the breadth of the embankment would permit its being raised fourteen feet, thereby more than doubling the capacity of the reservoir, the expense of which would be small in comparison with the advantage to be derived. The reservoir will be in readiness to be filled to its full capacity during the coming winter and spring, and with it completed I am confident that there will in future be no scarcity of water upon the Chenango canal, and if properly managed a considerable surplus may be thrown into the Erie canal at Utica, where it is greatly needed. Should it be thought advisable to render the reservoir system more perfect, I would suggest that the old feeder from the

south end of Summit level to Leland's pond, be cleaned out and brought into use.

This feeder has not been in use for many years, and why it was abandoned I am unable to learn, but it seems as if it were a mistaken policy to discontinue it, as with it any surplus might be turned into Leland's pond, to be used as circumstances require; whereas now the surplus is thrown into the creek and lost to the canal. No estimate has been made of the cost of this work, but my judgment is that it would be trifling, as it appears to have retained its form well for the time it has remained dry.

Rebuilding locks.—There were six locks placed under contract last year, but so late in the season that new stone could not be secured, and to use the old stone exclusively was impossible; they were therefore permitted to remain another season. Materials are now being delivered upon the work preparatory to their early completion.

The following locks upon this canal should be rebuilt as soon as practicable, viz: locks No. 52, 55, 61, 65, 78 and 79.

In selecting locks which most require rebuilding, where there are so many as upon this canal, it is difficult to decide, but those are first taken whose walls have settled into the chamber sufficient to prevent the free passage of boats; then those that are the cause of wasting the greatest amount of water, or by the rebuilding of which the greatest amount can be saved.

There are upon this canal 114 locks, four of which are of cut stone, and eight that have been rebuilt within a few years, leaving 102 old composite locks which should be rebuilt upon the present improved plan within the next ten or twelve years, for the best can hardly be expected to stand longer.

EXTENSION OF CHENANGO CANAL.

There are now thirty miles of this work under contract. The estimated cost of so much of the line as is now under contract, made by L. L. Nichols, engineer, prior to the letting of any portion of the work, is.....

\$1,099,350

Estimated cost of same work at contract prices.....

\$1,120,946

Estimated cost at contract prices in excess of engineer's estimate

\$21,596

The following table exhibits the work not under contract, with the length of sections and estimate of cost, as prepared by L. L. Nichols, Esq., engineer formerly in charge of the work:

| Character of work. | Length in chains. | Amounts. |
|---|-------------------|------------------|
| Dam and guard lock section..... | 74 | \$50,000 |
| Section 31, including culverts and bridges..... | 80 | 15,250 |
| 32, do | 80 | 20,200 |
| 33, do | 80 | 19,250 |
| 34, do | 80 | 18,000 |
| 35, do | 80 | 24,000 |
| 36, do | 80 | 21,750 |
| 37, do | 84 | 20,300 |
| 38, do | 80 | 13,650 |
| 39, do | 62 | 10,250 |
| Lock No. 6, 6 feet lift..... | | 12,405 |
| 7, 6 do | | 12,805 |
| 8, 8 do | | 14,030 |
| 9, 7 do | | 13,295 |
| 10, 12 do | | 18,725 |
| 11, 7 do | | 12,995 |
| Archibald's creek aqueduct, 2 spaces..... | | 10,662 |
| Wappasena creek aqueduct, 4 spaces..... | | 13,391 |
| Little Wappasena creek aqueduct, 2 spaces..... | | 10,662 |
| Parks' creek aqueduct, 1 space..... | | 9,136 |
| Five waste weirs | | 10,000 |
| Bridges on sections 11 to 30 inclusive | | 74,100 |
| | | <u>\$424,856</u> |

This estimate is based upon the line as located upon the south side of the Susquehanna river to where it intersects with the Pennsylvania State line. Should the line be located to cross the river upon the north side, at or near Barton, the work would be largely increased, inasmuch as an extensive dam would have to be constructed, together with the fact that the country through which it would be required to pass does not furnish so favorable a location.

It is desirable that the remaining portion of the line be placed under contract as early as possible, so as to insure the completion of the whole work as near the same time as practicable.

In table No. 2 it will be observed that the estimated cost of the

work at contract prices is in several cases largely increased beyond the amount reported last year; but in my opinion the engineers estimate for the whole line, reported at the same time, amounting to \$1,524,206, will very nearly if not quite cover the entire cost upon the present contemplated line; as the revised estimates make liberal allowances for undeveloped contingencies exclusive of engineering and land damage.

For the causes of such increase in the estimated cost at contract prices, as well as the detailed condition of the work under contract, I respectfully refer you to the following report of Byron M. Hanks, the resident engineer in charge:

ENGINEER'S OFFICE, OWEGO, *Sept. 30, 1866.*

W. H. H. GERE, Esq., *Division Engineer:*

According to your directions I submit the following report, relative to so much of the extension of the Chenango canal as is now under contract. I entered upon the duties of resident engineer of said canal, on the 15th day of June, 1866, at which time the following sections and groups of mechanical structures became and were under contract, viz:

Sections Nos. 1 to 10 inclusive, were let June 22, 1865.

All bridges on sections 1 to 5 inclusive, June 22, 1865.

All bridges on sections 6 to 10 inclusive, June 22, 1865.

All culverts on sections 1 to 5 inclusive, June 22, 1865.

All culverts on sections 6 to 10 inclusive, June 22, 1865.

Locks Nos. 1, 2 and 3, June 22, 1865.

Sections Nos. 11 to 20 inclusive, February 7, 1866.

All culverts on sections Nos. 11 to 20 inclusive, Feb. 7, 1866.

Locks Nos. 4 and 5, February 7, 1866.

Choconut, Tracy and Apalachin creek Aqueducts, Feb. 7, 1866.

Sections Nos. 21 to 30, June 15, 1866.

All culverts on sections No's. 21 to 30 inclusive, June 15, 1866.

Work remaining to be let is as follows:

Section 31 to state line.

All bridges from section No. 11 to State line.

All culverts from section No. 31 to State line.

One aqueduct four spaces across Big Wappasena creek on sec. 32.

One aqueduct two spaces across Little Wappasena creek on sec. 33.

One aqueduct one space across Park's creek on sec. 39.

One aqueduct two spaces across Archibalds creek on sec. 24.

Also one dam and guard lock at Binghamton.

Only one waste wier has as yet been let, and that is in connection with section No. 2 and included in the same contract. Provision has been made for the construction of waste gates in each of the aqueducts now under contract. In addition however, I think some additional waste wiers should be constructed between sections No. 2 and 11.

Two railroad bridges are now required; one for the Binghamton and Syracuse, and the other for the New York and Erie railroads. These structures I have regarded as included in the contract for all bridges from sections 1 to 5 inclusive, and have included their cost in estimate for that group. Another railroad bridge will likewise be required for the Albany and Susquehanna railroad. The last named bridge I suppose the railroad company will build for themselves when needed.

The work on sections Nos. 1, 5, 6, 7, 8, 9, and 13, was well advanced when I took charge, and several other sections had just commenced. Work is now in progress under all the contracts except the following:

Sections Nos. 15, 19, 20, 21, 24, 25, 28 and 29, culverts from sections 21 to 30, and the contractors for sections 24, 28 and 29 and the last group of culverts, have been notified to begin their work.

The cost of constructing the work will exceed the estimated cost, at contract prices, as reported last year, for various reasons, many of which could not certainly have been foreseen previous to opening the work, as for instance, the classification of material, the proper method of finishing the prism where quick sand and other unstable material occurs, also in the method of protecting the banks of sections built in the river, where the original estimate was based, on the supposition that a simple slope wall of heavy stone would be adopted—rip-raps and loose stone protection, and in one instance rubble masonry in cement have been substituted.

The reason for not using slope wall, as so originally intended, was because stone in sufficient quantities could not be had without great trouble and expense. While there was abundance of material for loose stone protection and rip-rap, and while the price of the latter has generally been about the same as that of slope and protection wall, and sometimes considerable less, yet the quantity generally exceeds considerably the amount that was estimated of slope and protection wall for the same locality. On section No. 5 vertical wall in cement was deemed necessary to save a valuable

mill site, and was constructed along the race, which otherwise would have been filled up.

The item of excavation on nearly all the sections will be increased over the original estimate, as more or less outside ditches and extra excavations always occur that were not foreseen in getting up the approximate quantities. The construction of roads also increase the cost of several sections, where it seems no estimate had been made by former engineer in charge, but where the roads are to any great extent changed, generally the object gained is the saving of road and farm bridges. Rock excavations have occurred on several sections where none was anticipated, and where it was known to exist it has generally been found in larger quantities than the former engineer expected. These facts only develop themselves in the progress of the work.

Sections Nos. 2, 5, 6, 9, 11 and 17 are examples thus far of increased cost on account of the occurrence of rock in unexpected quantities. Section No. 26 exceeds the engineer's estimate somewhat largely, as do several other sections and groups. Originally the principal item of work was embankment, occasioned by locating the canal far out in the river, at a point, too, known as the narrows, where in times of freshets there is a great depth of water and a violent current.

My estimate of the cost of constructing this section is based on the supposition that the line should be thrown more into the bluff, which increases the excavation and diminishes the embankment.

This change I consider necessary, firstly, for the safety of the work; next, the land owners on the opposite side of the river, where the bank is low, would be greatly damaged by any narrowing of the channel, which would cause an increased height of water in flood times: and again, if the embankment should be built, a large area of land must necessarily be taken above and below the narrows for borrowing pits, which the State would have to pay for, thereby virtually increasing the cost of the section by way of land damages, when the material on the hill side and bluffs would answer every purpose for building the great bulk of bank exactly as well. I have made allowance for the contingency of any landslide that may be likely to occur from the steep hill side after making excavation along the base of the bluff. I think the estimate is large. In making the location of the line of this section, I have followed the example of the most experienced engineers in the location of canals at points of like character in the State of Pennsylvania, which have stood the test of time and shock of floods.

Section No. 5 owes its principal cause of increase to the vertical wall in cement, to save the mill race before spoken of, and the unexpectedly large amount of rock excavation, and in the increased amount of protection wall.

On section No. 8 the earth excavation is far in excess of the approximate estimate of the engineer, and then it became necessary to support the sides of the prism through a deep sand cut with sheet docking.

Supposing section No. 6 would be of a similar character, I have anticipated a similar outlay, and the same on section No. 18.

Section No. 23 is increased heavily by a change of the location of the highway nearly the whole length of the section, by which means three or four bridges are dispensed with. A large amount of loose stone protection was found necessary, which was not provided for in the engineer's approximate estimate; also a quantity of sheet piling docking through the business portion of Owego. The same may be said of section 24. All the other sections are increased a little in earth excavation, lining, puddling, and timber for temporary bridges.

The first group of bridges are nearly doubled, for the reason that I have included the supposed cost of two railroad bridges, not included in the approximate estimate.

All the mechanical structures are somewhat increased for various reasons, such as turning or changing in some respects creek channels, and to meet other contingencies expected to arise.

The culverts in particular are largely increased, owing to the fact that most, if not all of them, as estimated by the former engineer, were of insufficient dimensions for the streams of this hilly country, which are liable to sudden changes from destructive mountain streams to dry channels. The number of these structures has also been increased to accommodate water courses, apparently heretofore overlooked and not provided for. The aggregate cost, as estimated by me, falls short of the approximate estimate made previous to the letting.

The progress of the construction of the extension has not been what we could desire, owing mainly to the scarcity and consequent dearness of labor, still there has been a commendable disposition on the part of the contractors to meet and overcome every obstacle.

Lumber, though not so abundant as formerly, is yet to be had on this line at reasonable rates, while good stone is a great desideratum, in fact it is impossible to procure such stone as the specifications call for in the locks and aqueducts without going to an

expense never contemplated by the State officers having this work in charge or the contractors in procuring the same.

So thoroughly am I satisfied of the impossibility of procuring suitable stone for the more important structures, such as locks, aqueducts and large arch culverts, that I do not hesitate in the case of the locks to recommend that timber be substituted instead of stone.

The argument in favor of wooden locks is too familiar to need recapitulation.

(Signed)

BYRON M. HANKS,

Resident Engineer.

ORDINARY REPAIRS PERFORMED BY THE REPAIR CONTRACTORS.

Under this head it is impossible to note all the work done in detail over which the engineer department has, in some manner, performed supervising service, the more important work always requires the constant attention of this department.

During the suspension of navigation last winter, the prism of all the canals of this division were put in condition by removing accumulated sediment and bars and repairing slope walls and docking.

The gates to the locks were repaired, and where required, new ones substituted, and during the summer the towing path has for much of its length been thoroughly graveled.

New bridge superstructures have been constructed to replace those that have failed or were considered absolutely dangerous, and generally upon the same plan as the old superstructures.

The matter of bridges has become one of serious importance; the plan of wood superstructure, adopted and built since 1850, is not what safety to the public demands. Bridges have fallen this season, with people and teams upon them, that to all appearances were as reliable as when first built; fortunately, however, no lives have been lost in consequence. There are many superstructures upon the enlarged canals that will require rebuilding during the next year; and, in my judgment, all highway bridges should be of iron.

CAYUGA MARSHES.

The principal extraordinary repairs, that will be necessary during the coming season, is the raising, strengthening and further protection of the high embankments across the Cayuga marshes.

These banks were built upon the surface of the marshes, and are continually settling. They have been raised since the work was completed and now require it again. The berme bank, in

particular, should be widened, as well as raised, as it is too light to sustain with safety the required head of water. I think that the sum of \$30,000 should be expended upon this work; for a break at this point would be a disaster, the damage of which could hardly be estimated.

Vertical Walls.—Further conveniences for loading and unloading boats upon the Syracuse level, by way of vertical wall or docking, should be provided. The business done at this point has so extended, that the works of that character, provided at the time of the enlargement, accommodate only a small portion of manufacturing interests of this locality.

Swing bridge, at Oak Orchard, on the Oneida River improvement, authorized by act chapter 896, Laws of 1866, is now in process of construction, and will be completed by the first of December next.

The dam at Oak Orchard requires repairs. The manner of its original construction, I think, was faulty in several respects, as, during high water nearly every spring, a portion of the top timbers are carried away, endangering the entire destruction of the structure.

I recommend that an improvement be made by reducing the top timbers and covering the upper surface with shear plank of hard wood, and the whole thoroughly spiked or bolted to the timber; the spars in the dam should be bolted to the timber below—the treenails originally used being inadequate to retain them in their places. When done, and whole of the upper side of the dam properly graveled, the structure must be secure for many years.

The old guard-lock at Baldwinsville, a timber structure, had become entirely worthless by decay, a new guard gate of stone has been constructed in its stead, the approaches thereto thoroughly bottomed out, and the banks properly protected at an expense of \$10,985.70. The appropriation being but \$10,000, only that sum has been paid therefor.

Lock No. 6, at Seneca Falls, on the Cayuga and Seneca canal, has caused a great deal of trouble by the pressing or settling of side walls into the chamber of the lock. This is what is known as a composite lock, the chamber walls being of stone, laid dry, and the front faced with timber and plank.

Since 1861 this lock has been bailed out four times at great expense each time, and in 1862 the timber work was removed and new timber substituted, with concrete placed between wall and

face lining. Last spring the concrete was partly removed, timbers hewn down, and but one course of lining put on instead of two. In that condition it has been used the past season, but not without difficulty and delay. It is urgently recommended that the dry masonry be taken up next winter and relaid in cement, on the plan now adopted for rebuilding locks upon the Chenango canal. The cost of the work will be about \$6,300.

All the locks upon the Crooked Lake canal are of the same character as those upon the Cayuga and Seneca canal. The foundations to seven or eight of these locks seem to be defective; the jaws and lower wings are constantly pressing together, requiring the face of walls to be dressed off so as to allow the passage of boats.

This has been done to such an extent that the locks are liable to fail at any time. Such walls should be taken up. New stone procured if necessary and relaid in cement. The hills upon the berme side of this canal are in many cases inclined to slide into the canal. Piles have been driven at the foot of the slope at some of these points, which answer a good purpose. The remaining places should be protected in the same manner.

FRESHET DAMAGE.

The repairs of the damages caused by the flood of March, 1865, were completed during the forepart of the present fiscal year, and the accounts have all been settled. The cost of the work and the amount paid thereon during the year will be found in table No. 3.

EXTRAORDINARY REPAIRS.

The work done under this head, and cost thereof, is shown in table No. 3. A recapitulation of each piece of work, its character, etc., is not deemed of importance, as it was in each case authorized by the Canal Board, based upon an estimate of the cost made by the Division Engineer and approved by the board of Canal Commissioners, the wisdom of the expenditure for which, experience can but justify.

In conclusion I am happy in being able to report that, with the exception of a few slight breaks and detentions, which are not of enough importance to mention in detail, navigation has been maintained upon this division throughout the entire season without interruption.

Respectfully submitted,

WILLIAM H. H. GERE, *Division Engineer.*

TABLE No. 1.

Statement showing name, number of days and compensation of engineers upon the repairs of the Middle Division of the New York State canals, together with incidental expenses of the department during the fiscal year ending September 30th, 1866

[Assem. No. 27.]

ERIE CANAL.

| NAME. | NATURE OF SERVICE. | Number of days. | Rate of compensation. | Amounts. |
|---------------------------------|---------------------------|-----------------|-----------------------|-------------------|
| J. Platt Goodsell | Division engineer, salary | --- | \$2,000 00 | \$300 00 |
| J. Platt Goodsell | Division engineer, travel | --- | --- | 60 00 |
| W. H. H. Gere | Division engineer, salary | --- | 2,000 00 | 428 33 |
| W. H. H. Gere | Division engineer, travel | --- | --- | 69 60 |
| W. H. H. Gere | Resident engineer, salary | --- | 1,700 00 | 230 00 |
| W. H. H. Gere | Resident engineer, travel | --- | --- | 50 08 |
| Howard Soule, jr | Resident engineer, salary | --- | 1,700 00 | 355 00 |
| Howard Soule, jr | Resident engineer, travel | --- | --- | 81 32 |
| W. D. Dunning | Assistant in office | 34 | 4 50 | 153 00 |
| Hulbert Vroman | Rodman | 312 | 2 00 | 624 00 |
| | | | | <u>\$2,351 33</u> |
| <i>Incidental Expenses.</i> | | | | |
| Stationery | --- | --- | --- | \$130 03 |
| Postage, telegraph and expenses | --- | --- | --- | 135 87 |

TABLE No. 1--(Continued).

| NAME. | NATURE OF SERVICE. | Number of days. | Rate of compensation. | Amounts. |
|----------------------|----------------------------|-----------------|-----------------------|-------------------|
| Fuel and light | | | | \$99 09 |
| Miscellaneous | | | | 192 15 |
| | | | | <u>\$557 14</u> |
| Total for Erie canal | | | | <u>\$2,908 47</u> |
| OSWEGO CANAL. | | | | |
| J. Platt Goodsell | Division engineer, salary. | | \$2,000 00 | \$50 00 |
| J. Platt Goodsell | Division engineer, travel. | | | 8 00 |
| W. H. H. Gere | Division engineer, salary. | | 2,000 00 | 185 00 |
| W. H. H. Gere | Division engineer, travel. | | | 35 68 |
| W. H. H. Gere | Resident engineer, salary. | | 1,700 00 | 150 00 |
| W. H. H. Gere | Resident engineer, travel. | | | 25 36 |
| Howard Soule, jr. | Resident engineer, salary. | | 1,700 00 | 110 00 |
| Howard Soule, jr. | Resident engineer, travel. | | | 28 28 |
| W. D. Dunning | Assistant in office | 26 | 4 50 | 117 00 |
| | | | | <u>\$709 32</u> |

Incidental Expenses.

| | | | | |
|------------------------------|--|--|--|-----------------|
| Stationery | | | | \$28 00 |
| Telegraph | | | | 4 29 |
| | | | | <u>\$32 29</u> |
| Total for Oswego canal | | | | <u>\$741 61</u> |

CAYUGA AND SENECA CANAL.

| | | | | | |
|---|--|--|--|------------|-----------------|
| J. Platt Goodsell | | | | \$2,000 00 | \$75 00 |
| J. Platt Goodsell | | | | | 12 00 |
| W. H. H. Gere | | | | 1,700 00 | 70 00 |
| W. H. H. Gere | | | | | 14 20 |
| Howard Soule, jr. | | | | 1,700 00 | 280 00 |
| Howard Soule, jr. | | | | | 62 32 |
| | | | | | <u>\$513 52</u> |
| <i>Incidental Expenses.</i> | | | | | |
| Telegraph | | | | | \$28 28 |
| Miscellaneous | | | | | 8 00 |
| | | | | | <u>\$36 28</u> |
| Total for Cayuga and Seneca canal | | | | | <u>\$549 80</u> |

TABLE No. 1—Continued.

| NAME. | NATURE OF SERVICE. | Number of days. | Rate of compensation. | Amounts. |
|-----------------------------------|--------------------------------|-----------------|-----------------------|----------|
| CROOKED LAKE CANAL. | | | | |
| W. H. H. Gere..... | Division engineer, salary..... | ----- | \$2,000 00 | \$120 00 |
| W. H. H. Gere..... | Division engineer, travel..... | ----- | ----- | 23 12 |
| Howard Soule, jr..... | Resident engineer, salary..... | ----- | 1,700 00 | 75 00 |
| Howard Soule, jr..... | Resident engineer, travel..... | ----- | ----- | 12 04 |
| <i>Incidental Expenses.</i> | | | | |
| Telegraph..... | ----- | ----- | ----- | \$230 16 |
| Total for Crooked Lake canal..... | ----- | ----- | ----- | 10 92 |
| | ----- | ----- | ----- | \$241 08 |
| CHEMUNG CANAL. | | | | |
| W. H. H. Gere..... | Division engineer, salary..... | ----- | \$2,000 00 | \$225 00 |
| W. H. H. Gere..... | Division engineer, travel..... | ----- | ----- | 40 44 |
| W. D. Dunning..... | Assistant in office..... | 18 | 4 50 | 81 00 |
| <i>Incidental Expenses.</i> | | | | |
| Telegraph..... | ----- | ----- | ----- | \$346 44 |
| Total for Chemung canal..... | ----- | ----- | ----- | 9 68 |
| | ----- | ----- | ----- | \$356 12 |

CHENANGO CANAL.

| | | | |
|--------------------------------|--------------------------------|------------|-------------------|
| J. Platt Goodsell..... | Division engineer, salary..... | \$2,000 00 | \$75 00 |
| J. Platt Goodsell..... | Division engineer, travel..... | | 20 00 |
| W. H. H. Gere..... | Division engineer, salary..... | 2,000 00 | 375 00 |
| W. H. H. Gere..... | Division engineer, travel..... | | 57 40 |
| W. H. H. Gere..... | Resident engineer, salary..... | 1,700 00 | 116 65 |
| W. H. H. Gere..... | Resident engineer, travel..... | | 24 40 |
| Howard Soule, jr..... | Resident engineer, salary..... | 1,700 00 | 313 33 |
| Howard Soule, jr..... | Resident engineer, salary..... | | 79 84 |
| | | | <u>\$1,061 63</u> |
| <i>Incidental Expenses.</i> | | | |
| Stationery..... | | | \$36 09 |
| Telegraph..... | | | 43 39 |
| | | | <u>\$79 48</u> |
| Total for Chenango canal..... | | | <u>\$1,141 11</u> |
| Total for Middle Division..... | | | <u>\$5,938 19</u> |

TABLE No. 1—Continued.

Statement showing name, nature of service, number of days, and compensation of Engineers employed upon construction of the extension of the Chenango canal, for the fiscal year ending September 30, 1866, as authorized by act chapter 185 Laws of 1864.

| NAME. | NATURE OF SERVICE. | No. of days. | Compensation. | Amounts. |
|--------------------|----------------------------|--------------|---------------|----------|
| Byron M. Hanks | Resident engineer, salary. | ----- | \$2,000 00 | \$583 33 |
| Byron M. Hanks | Resident engineer, travel. | ----- | ----- | 146 15 |
| L. L. Nichols | First assistant engineer | 169 | 5 50 | 929 50 |
| John Evans | Second assistant engineer | 312 | 4 50 | 1,404 00 |
| George Cushing, jr | Second assistant engineer | 173 | 4 50 | 778 50 |
| Charles A. Beach | Second assistant engineer | 132 | 4 50 | 594 00 |
| Thomas M. Sherman | Second assistant engineer | 67 | 4 50 | 301 50 |
| C. Q. Newcomb | Second assistant engineer | 58 | 4 50 | 261 00 |
| John Bisgood | Draughtsman | 7 | 5 00 | 35 00 |
| D. Richmond | Draughtsman | 39 | 4 50 | 175 50 |
| D. Richmond | Draughtsman | 78 | 4 00 | 312 00 |
| L. F. Olney | Draughtsman | 78 | 4 00 | 312 00 |
| C. B. Gerrard | Leveler | 258 | 3 50 | 903 00 |
| R. A. Hartwell | Leveler | 122 | 3 50 | 427 00 |
| L. F. Olney | Leveler | 192 | 3 50 | 672 00 |
| M. E. McEntee | Leveler | 24 | 3 50 | 84 00 |
| B. F. Bradley | Rodman | 312 | 3 00 | 936 00 |
| H. T. Robinson | Rodman | 126 | 3 00 | 378 00 |
| Joseph Kasson | Rodman | 114 | 3 00 | 342 00 |

| | | | | |
|--|----------------------|-----|------|-------------|
| Charles E. Bradley | Rodman | 3 | 2 50 | 7 50 |
| Emil Knichling | Rodman | 66 | 3 00 | 198 00 |
| Oscar Whitford | Rodman | 41 | 3 00 | 123 00 |
| E. P. Edwards | Rodman | 78 | 3 00 | 234 00 |
| A. R. Webb | Tapeman and chainman | 72 | 2 50 | 180 00 |
| Samuel Morse | Tapeman and chainman | 22 | 2 50 | 55 00 |
| B. Ahleß | Axeman | 108 | 2 50 | 270 00 |
| W. M. Morse | Axeman | 126 | 2 50 | 315 00 |
| Orrin Kellum | Axeman | 106 | 2 50 | 265 00 |
| James Barnes | Axeman | 20 | 2 50 | 50 00 |
| James Spencer | Axeman | 7 | 2 50 | 17 50 |
| Luther Edwards | Axeman | 1 | 2 50 | 2 50 |
| L. H. Spencer | Inspector | 75 | 4 00 | 300 00 |
| J. B. Simmonds | Inspector | 41 | 3 00 | 123 00 |
| H. W. Shipman | Inspector | 41 | 3 00 | 123 00 |
| J. W. Webber | Inspector | 88 | 3 00 | 264 00 |
| <i>Incidental Expenses.</i> | | | | \$12,101 98 |
| Stationery | | | | \$290 61 |
| Postage, telegraph and express | | | | 21 74 |
| Office rent, fuel and light. | | | | 245 98 |
| Miscellaneous | | | | 200 64 |
| | | | | 758 97 |
| Total for extension of Chenango canal, | | | | \$12,860 95 |

TABLE No. 1—Continued.

Statement showing name, nature of service, number of days, and compensation of Engineers employed upon construction of the extension of the Chenango canal, for the fiscal year ending September 30, 1866, as authorized by act chapter 185 Laws of 1864.

| NAME. | NATURE OF SERVICE. | No. of days. | Compensation. | Amounts. |
|--------------------|---------------------------|--------------|---------------|----------|
| Byron M. Hanks | Resident engineer, salary | ----- | \$2,000 00 | \$583 33 |
| Byron M. Hanks | Resident engineer, travel | ----- | ----- | 146 15 |
| L. L. Nichols | First assistant engineer | 169 | 5 50 | 929 50 |
| John Evans | Second assistant engineer | 312 | 4 50 | 1,404 00 |
| George Cushing, jr | Second assistant engineer | 173 | 4 50 | 778 50 |
| Charles A. Beach | Second assistant engineer | 132 | 4 50 | 594 00 |
| Thomas M. Sherman | Second assistant engineer | 67 | 4 50 | 301 50 |
| C. Q. Newcomb | Second assistant engineer | 58 | 4 50 | 261 00 |
| John Bisgood | Draughtsman | 7 | 5 00 | 35 00 |
| D. Richmond | Draughtsman | 39 | 4 50 | 175 50 |
| D. Richmond | Draughtsman | 78 | 4 00 | 312 00 |
| L. F. Olney | Draughtsman | 78 | 4 00 | 312 00 |
| C. B. Gerrard | Leveler | 258 | 3 50 | 903 00 |
| R. A. Hartwell | Leveler | 122 | 3 50 | 427 00 |
| L. F. Olney | Leveler | 192 | 3 50 | 672 00 |
| M. E. McEntee | Leveler | 24 | 3 50 | 84 00 |
| A. F. Bradley | Rodman | 312 | 3 00 | 936 00 |
| T. Robinson | Rodman | 126 | 3 00 | 378 00 |
| mph Kasson | Rodman | 114 | 3 00 | 342 00 |

STATE ENGINEER AND SURVEYOR.

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| | | | |
|--|-----|------|-------------|
| Charles E. Bradley | 192 | 3 00 | 6 02 00 |
| Levelling | 24 | 3 50 | 84 00 |
| Stationing | 192 | 3 00 | 0 00 00 |
| Surveying | 192 | 3 00 | 0 00 00 |
| Rodman | 3 | 2 50 | 7 50 |
| Rodman | 66 | 3 00 | 198 00 |
| Rodman | 41 | 3 00 | 123 00 |
| Rodman | 78 | 3 00 | 234 00 |
| Tapeman and chainman | 72 | 2 50 | 180 00 |
| Tapeman and chainman | 22 | 2 50 | 55 00 |
| Axeman | 108 | 2 50 | 270 00 |
| Axeman | 126 | 2 50 | 315 00 |
| Axeman | 106 | 2 50 | 265 00 |
| Axeman | 20 | 2 50 | 50 00 |
| Axeman | 7 | 2 50 | 17 50 |
| Inspector | 1 | 2 50 | 2 50 |
| Inspector | 75 | 4 00 | 300 00 |
| Inspector | 41 | 3 00 | 123 00 |
| Inspector | 41 | 3 00 | 123 00 |
| Inspector | 88 | 3 00 | 264 00 |
| Postage, telegraph and express | | | \$12,101 98 |
| Office rent, fuel and light | | | \$290 61 |
| Miscellaneous | | | 21 74 |
| | | | 245 98 |
| | | | 200 64 |
| Total for extension of Chenango canal. | | | 758 97 |
| | | | \$12,860 95 |

mental Expenses.

TABLE No. 1—Continued.

Statement showing name, location, number of days, and compensation of assistants employed upon the repairs of the Middle Division, during the fiscal year ending September 30th, 1866, and paid by Canal Commissioners or superintendents.

| NAMES. | LOCATION. | Number of days. | Compensation. | Amounts. | Total. |
|----------------------------|---------------------|-----------------|---------------|----------|------------|
| Howard Soule, Jr. | Erie canal | 78 | \$4 00 | \$312 00 | |
| W. D. Dunning | Erie canal | 234 | 4 00 | 936 00 | \$1,248 00 |
| M. S. Kimball | Oswego canal | 78 | 4 50 | 351 00 | |
| M. S. Kimball | Oswego canal | 234 | 4 00 | 936 00 | |
| W. V. Van Rensselaer | Oswego canal | 156 | 4 00 | 624 00 | |
| W. V. Van Rensselaer | Oswego canal | 156 | 3 50 | 546 00 | |
| Clark Breed | Oswego canal | 121 | 2 00 | 242 00 | |
| Patrick Murphy | Oswego canal | 313 | 2 00 | 626 00 | 3,325 00 |
| D. E. Whitford | Chemung canal | 52 | 4 50 | 234 00 | |
| D. E. Whitford | Chemung canal | 260 | 4 00 | 1,040 00 | |
| O. M. Claugharty | Chemung canal | 312 | 3 00 | 936 00 | |
| Henry Cooper | Chemung canal | 52 | 3 75 | 195 00 | |
| Henry Cooper | Chemung canal | 104 | 2 50 | 260 00 | |
| R. A. Hartwell | Chemung canal | 54 | 3 00 | 162 00 | 2,827 00 |

| | | | | | |
|----------------------|----------------------|-----|------|----------|-------------------|
| O. H. Bogardus | Chenango canal | 312 | 3 75 | 1,170 00 | |
| M. N. Campbell | Chenango canal | 20 | 2 25 | 45 00 | |
| M. N. Campbell | Chenango canal | 20 | 2 00 | 40 00 | |
| Total | | | | | 1,255 00 |
| | | | | | <u>\$8,655 00</u> |

SUMMARY OF TABLE No. 1.

| | |
|---|--------------------|
| Repairs proper | \$5,938 19 |
| Repairs, ordinary and extraordinary | 8,655 00 |
| Chenango Canal extension | 12,860 95 |
| Total | <u>\$27,454 14</u> |

TABLE No. 2.

Statement showing character of work, estimated cost at contract prices, amount done during fiscal year ending September 30th, 1866, total amount done and amount remaining to be done on work under contract on Middle Division of New York State canals.

| CHARACTER OF WORK. | Estimated cost at contract prices. | Amount done during fiscal year. | Total amount done. | Amount remaining to be done. |
|---------------------------------------|------------------------------------|---------------------------------|--------------------|------------------------------|
| ERIE CANAL. | | | | |
| Improvement of Nine Mile Creek feeder | \$3,000 00 | ----- | \$1,540 00 | \$1,460 00 |
| Temporary feeder at Port Byron | 10,173 78 | \$10,173 78 | 10,173 78 | - Settled. |
| Opening State Ditch at Port Byron | 5,220 00 | ----- | ----- | 5,220 00 |
| Iron bridge at Grape St., Syracuse | 9,771 00 | 840 00 | 840 00 | 8,931 00 |
| Improvement Oneida Creek feeder | 4,435 74 | 2,260 00 | 2,260 00 | 2,175 74 |
| Totals | \$32,600 52 | \$13,273 78 | \$14,813 78 | \$17,786 74 |
| OSWEGO CANAL. | | | | |
| Wigh lock at Oswego | \$46,500 00 | \$12,080 00 | \$44,400 00 | \$2,100 00 |
| Scale for lock at Oswego | 4,650 00 | 4,650 00 | 4,650 00 | - Settled. |
| Stone dam at Phenix | 56,105 00 | 23,500 00 | 45,420 00 | 10,685 00 |
| Stone dam at Oswego Falls | 30,600 00 | 12,360 00 | 12,360 00 | 18,240 00 |
| Stone dam at Braddock's Rapids | 60,000 00 | ----- | ----- | 60,000 00 |
| Berne bank in Oswego river | 180,000 00 | 55,100 00 | 72,800 00 | 107,200 00 |

| | | | | |
|--|--------------|--------------|--------------|--------------|
| High dam completion ----- | 36,483 77 | 12,663 77 | 36,483 77 | Settled. |
| Iron-chord bridge at Oswego ----- | 1,621 50 | ----- | ----- | 1,621 50 |
| Totals ----- | \$415,960 27 | \$120,353 77 | \$216,113 77 | \$199,846 50 |
| CHEMUNG CANAL. | | | | |
| Work in Chemung river at Corning, at old contract prices ----- | \$70,000 00 | \$14,140 00 | \$62,180 00 | \$7,820 00 |
| Work in Chemung river at Corning, at additional prices authorized by act chap. 495 Laws of 1865, ----- | 45,000 00 | 36,100 00 | 36,100 00 | 8,900 00 |
| Repairs of lock No. 1 ----- | 9,155 00 | ----- | ----- | 9,155 00 |
| do 24 ----- | 4,855 22 | 4,855 22 | 4,855 22 | Settled. |
| do 25 ----- | 5,126 13 | 5,126 13 | 5,126 13 | do |
| do 28 ----- | 5,982 45 | 5,982 45 | 5,982 45 | do |
| do 32 ----- | 5,437 13 | 5,437 13 | 5,437 13 | do |
| do 36 ----- | 6,195 00 | ----- | ----- | 6,195 00 |
| do 40 ----- | 6,195 00 | ----- | ----- | 6,195 00 |
| Highway bridge over feeder in town of Corning ----- | 919 44 | 919 44 | 919 44 | Settled. |
| Selser Swing bridge at Watkins ----- | 3,775 00 | ----- | ----- | 3,775 00 |
| Totals ----- | \$162,640 37 | \$72,560 37 | \$120,600 37 | \$42,040 00 |
| CHENANGO CANAL. | | | | |
| Rebuilding Kingley's Brook reservoir ----- | \$75,500 00 | \$40,540 00 | \$55,260 00 | \$20,240 00 |
| Rebuilding lock No. 56 ----- | 9,264 00 | 780 00 | 780 00 | 8,484 00 |

TABLE No. 2—Continued.

| CHARACTER OF WORK. | Estimated cost at contract prices. | Amount done during fiscal year. | Total amount done. | Amount remaining to be done. |
|-----------------------------|------------------------------------|---------------------------------|--------------------|------------------------------|
| CHENANGO CANAL—Continued. | | | | |
| Rebuilding lock No. 60..... | \$9,044 00 | \$780 00 | \$780 00 | \$8,264 00 |
| do 77..... | 7,831 00 | ----- | ----- | 7,831 00 |
| do 105..... | 6,701 00 | ----- | ----- | 6,701 00 |
| do 106..... | 5,747 00 | ----- | ----- | 5,747 00 |
| do 107..... | 9,669 00 | ----- | ----- | 9,669 00 |
| Totals | \$123,756 00 | \$42,100 00 | \$56,820 00 | \$66,936 00 |

TABLE No. 2—Continued.

Statement showing the character of work, engineer's estimates, estimated cost at contract prices, amount done during the fiscal year ending September 30, 1866, total amount done and amount remaining to be done on work under contract on the extension of the Chenango canal.

| Length in chains. | CHARACTER OF WORK. | Engineer's estimate. | Estimated cost at contract prices. | Amount done during the fiscal year. | Total amount done. | Amount remaining to be done. |
|-------------------|--------------------|----------------------|------------------------------------|-------------------------------------|--------------------|------------------------------|
| 62---- | Section No. 1----- | \$13,095 | \$11,145 | \$4,400 | \$7,340 | \$3,805 |
| 71---- | do 2----- | 57,915 | 47,980 | 16,240 | 16,240 | 31,740 |
| 80---- | do 3----- | 34,595 | 33,212 | 6,060 | 6,060 | 27,152 |
| 80---- | do 4----- | 92,670 | 52,697 | 2,800 | 2,800 | 49,867 |
| 90---- | do 5----- | 56,690 | 60,555 | 26,340 | 30,940 | 29,615 |
| 90---- | do 6----- | 50,695 | 49,702 | 16,860 | 16,960 | 32,742 |
| 80---- | do 7----- | 43,095 | 28,880 | 16,420 | 17,000 | 12,880 |
| 80---- | do 8----- | 21,185 | 30,000 | 23,960 | 26,200 | 3,800 |
| 80---- | do 9----- | 12,745 | 17,060 | 11,160 | 14,520 | 2,540 |
| 80---- | do 10----- | 15,430 | 14,154 | 1,800 | 4,620 | 9,534 |
| 76---- | do 11----- | 30,650 | 24,180 | 9,300 | 9,300 | 14,880 |
| 84---- | do 12----- | 17,050 | 18,480 | 7,000 | 7,000 | 11,480 |
| 80---- | do 13----- | 12,130 | 9,010 | 7,560 | 7,560 | 1,450 |
| 80---- | do 14----- | 14,150 | 17,500 | 4,520 | 4,520 | 12,980 |
| 80---- | do 15----- | 12,650 | 15,050 | ----- | ----- | 15,050 |
| 80---- | do 16----- | 22,650 | 18,150 | 7,540 | 7,540 | 10,610 |
| 84---- | do 17----- | 21,000 | 27,400 | 860 | 860 | 26,540 |

TABLE No. 2—Continued.

| Length in chains. | CHARACTER OF WORK. | Engineer's estimate. | Estimated cost at contract prices. | Amount done during the fiscal year. | Total amount done. | Amount remaining to be done. |
|-------------------|--|----------------------|------------------------------------|-------------------------------------|--------------------|------------------------------|
| 88---- | Section No. 18----- | \$57,800 | \$59,600 | \$21,300 | \$21,300 | \$38,300 |
| 80---- | do 19----- | 10,650 | 13,050 | 200 | 200 | 12,850 |
| 80---- | do 20----- | 23,700 | 22,000 | ----- | ----- | 22,000 |
| 80---- | do 21----- | 39,650 | 37,650 | ----- | ----- | 37,650 |
| 80---- | do 22----- | 65,100 | 60,100 | ----- | ----- | 60,100 |
| 84---- | do 23----- | 12,050 | 22,600 | 9,900 | 9,900 | 12,700 |
| 84---- | do 24----- | 24,300 | 29,455 | ----- | ----- | 29,455 |
| 82---- | do 25----- | 12,500 | 16,100 | ----- | ----- | 16,100 |
| 80---- | do 26----- | 97,300 | 123,375 | 2,040 | 2,040 | 121,335 |
| 80---- | do 27----- | 11,200 | 9,756 | 420 | 420 | 9,336 |
| 85---- | do 28----- | 16,700 | 16,520 | ----- | ----- | 16,520 |
| 89---- | do 29----- | 7,950 | 9,365 | ----- | ----- | 9,365 |
| 80---- | do 30----- | 11,400 | 11,866 | 1,380 | 1,380 | 10,486 |
| | Lock No. 1, 7 feet lift----- | 12,247 | 11,206 | 1,220 | 1,220 | 9,986 |
| | do 2, 7 do----- | 11,872 | 10,730 | 1,320 | 1,320 | 9,410 |
| | do 3, 7 do----- | 12,822 | 11,996 | 900 | 900 | 11,096 |
| | do 4, 9 do----- | 15,355 | 14,676 | 2,280 | 2,280 | 12,396 |
| | do 5, 7 do----- | 12,995 | 13,696 | 2,600 | 2,600 | 11,096 |
| | Choconut Creek aqueduct, 4 spaces, 22 ft. each | 13,391 | 17,370 | - 2,020 | 2,020 | 15,350 |
| | Tracy do 1 do----- | 9,136 | 10,590 | 500 | 500 | 10,090 |
| | Apaluchin do 4 do----- | 13,391 | 16,587 | 4,300 | 4,300 | 12,287 |

| | | | | |
|---|-------------|-------------|-----------|-----------|
| Culverts on sections Nos. 1 to 5 inclusive... | 7,715 | 9,637 | ----- | 9,637 |
| do do 6 to 10 do --- | 9,067 | 14,340 | 2,660 | 11,680 |
| do do 11 to 20 do --- | 14,105 | 22,005 | 1,640 | 20,365 |
| do do 21 to 30 do --- | 16,695 | 23,863 | ----- | 23,863 |
| Bridges on sections Nos. 1 to 5 do --- | 12,930 | 20,433 | 300 | 20,133 |
| do do 6 to 10 do --- | 18,934 | 16,225 | 320 | 15,905 |
| Totals..... | \$1,099,350 | \$1,120,946 | \$218,120 | \$886,156 |

TABLE No. 3.

Statement showing amount of work done under supervision of Engineer Department on miscellaneous repairs authorized by Canal Board, and amount paid thereon during fiscal year ending September 30th, 1866.

| CHARACTER OF WORK. | Amount appro- priated. | Amount done. | Amount paid. |
|---|---------------------------|--------------|--------------|
| ERIE CANAL. | | | |
| Strengthening berme bank at Orville feeder..... | \$4,660 00 | \$4,425 40 | \$4,425 40 |
| Improvement at and on West Street bridge..... | 255 20 | 252 71 | 252 71 |
| Apron and discharge way for culvert near lock 50..... | 1,690 00 | 1,475 10 | 1,475 10 |
| Pile rack around culvert near lock 50..... | 225 00 | 225 00 | 225 00 |
| Iron railing to change bridge at May's Point..... | 221 50 | 221 50 | 221 50 |
| Protection of banks east of Montezuma and Seneca River aqueduct..... | 7,425 00 | 6,991 20 | 6,991 20 |
| Filling pond near lock No. 48..... | 375 00 | 375 00 | 375 00 |
| Repairing damages occasioned by freshet of March, 1865, sec. 9..... | ----- | 8,177 76 | 2,088 88 |
| Inserting new cradle to weigh lock, Syracuse..... | ----- | 2,362 63 | 2,362 63 |
| Bulkhead of stone in lower dam at Cazenovia..... | 1,323 50 | 1,195 50 | 1,195 50 |
| Ninety feet vertical wall, &c., at West street, Syracuse..... | 1,562 75 | 1,545 30 | 1,545 30 |
| Total..... | \$17,737 95 | \$27,247 10 | \$21,158 22 |
| OSWEGO CANAL. | | | |
| Docking in front of Salt Block, No: 139..... | \$187 00 | \$186 60 | \$186 60 |
| Three hundred and fifty feet vertical wall at Salt Springs store house..... | ----- | 2,421 73 | 2,421 73 |
| Repairing State dam at Baldwinsville..... | ----- | 2,266 43 | 2,266 43 |

| | | | |
|--|-------------|-------------|-------------|
| Guard gate at Baldwinsville | 10,000 00 | 10,985 70 | 10,000 00 |
| Gates at head of Salina and Liverpool culverts | 913 00 | 891 04 | 891 04 |
| Raising road bridge over south side cut | 472 00 | 234 85 | 234 85 |
| Temporary shute over berme bank at Fulton | 274 00 | 274 00 | 274 00 |
| Repairing damages occasioned by freshets of March, 1865, on Sec. No. 1 | ----- | 22,781 85 | 9,390 93 |
| Raising approaches &c., to Green Point bridge | ----- | 957 30 | 957 30 |
| Total | \$12,046 00 | \$40,999 50 | \$26,622 88 |
| CHEMUNG CANAL. | | | |
| Repairing damage occasioned by freshet of March, 1865 | ----- | \$7,047 10 | \$5,821 35 |
| Snyder's swing bridge at Fifth street, Elmira | \$2,176 62 | 2,604 80 | 2,176 62 |
| Raising and protecting banks | 14,800 00 | 14,493 85 | 14,493 85 |
| Totals | \$16,976 62 | \$24,145 75 | \$22,491 82 |
| CAYUGA AND SENECA CANAL. | | | |
| Extending docking on berme at Geneva | \$382 50 | \$288 00 | \$288 00 |
| Embankment at Seneca Falls and stone and gravel at Geneva | 387 00 | 387 00 | 387 00 |
| Excavating channel under iron bridge at Geneva | 254 74 | 254 74 | 254 74 |
| Waste weir at Seneca Falls | 1,876 00 | 1,579 62 | 1,579 62 |
| Totals | \$2,900 24 | \$2,509 36 | \$2,509 36 |

27.]

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TABLE No. 3—Continued.

| CHARACTER OF WORK. | Amount appro- priated. | Amount done. | Amount paid. |
|--|---------------------------|--------------|--------------|
| CHENANGO CANAL. | | | |
| Wood dam at head of Madison Brook feeder | \$234 77 | \$234 77 | \$234 77 |
| Repairing embankments at Eaton & Nelson Brook reservoirs | 2,738 11 | 2,738 11 | 2,738 11 |
| Repairing breaches occasioned by freshet of March, 1865,, on Sec. No. 3. | ----- | 5,517 46 | 4,292 61 |
| Grouting discharge sluice to Eaton Brook reservoir, and constructing gate house | 272 50 | 262 75 | 262 75 |
| Totals | \$3,245 38 | \$8,753 09 | \$7,528 24 |

SUMMARY.

Amount of work done in fiscal year.

| CANALS. | Work under contract. | Work not under contract. | Totals. |
|------------------------|-------------------------|-----------------------------|------------|
| Erie..... | 13,273 78 | 27,247 10 | 40,520 88 |
| Oswego..... | 120,353 77 | 40,999 50 | 161,353 27 |
| Chemung..... | 72,560 37 | 24,145 75 | 96,706 12 |
| Cayuga and Seneca..... | ----- | 2,509 36 | 2,509 36 |
| Chenango (proper)... | 42,100 00 | 8,753 09 | 50,853 09 |
| Chenango extension.. | 218,120 00 | ----- | 218,120 00 |
| | 466,407 92 | \$103,654 80 | 570,062 72 |

103 80

97-101

WESTERN DIVISION.

DIVISION ENGINEER'S OFFICE, }
ROCHESTER, Oct., 1866. }

Hon. J. P. GOODSSELL,

State Engineer and Surveyor:

Sir—In compliance with regulations, established under act chapter 169, Laws of 1862, I herewith submit a report of the expenses of the engineer department, together with statement showing the progress and present condition of the work upon the Western Division of the New York State canals for the fiscal year ending September 30th, 1866.

The canals embraced in this division are as follows:

Erie canal from east line of Wayne county to Buffalo, 148½ miles.

Genesee Valley canal from Rochester to

Millgrove 113½ miles.

Dansville branch of this canal from junc-

tion at Spraker's to Dansville 11 miles.

124½ miles.

Total 273 miles.

The navigable feeders are as follows:

Genesee River feeder at Rochester 2¼ miles.

Genesee River feeder at Oramel ¾ miles.

Total 3 miles.

The canals on this division are supplied with water from the following sources :

ERIE CANAL.

Lake Erie.

Tonawanda creek at Pendleton.

Oak Orchard and Tonawanda creek at Medina.

Genesee Valley canal at Rochester.

Genesee river at Rochester.

GENESEE VALLEY CANAL.

Allen's creek at Scottsville.
Genesee river at Mount Morris.
Caneseraga creek feeder, two miles north of Dansville.
Mill creek at Dansville.
Wiscoy Creek feeder.
Genesee River feeder at Oramel.
Rockville reservoir in Belfast.
Two branches of Black creek on summit.
Oil Creek reservoir on summit, two miles north of Cuba.
Champlain creek on summit at Cuba.
Griffin creek on summit at Cuba.
Ischua feeder from Ischua creek connects with south end of summit.
Haskell creek on extension.
Dodge creek at Portville on extension.
Osnago creek, south of Portville, on extension.
Allegany river at head of canal, Millgrove.

ERIE CANAL.

During the past year no interruption to navigation, worthy of notice, has been experienced, with the exception of that caused by the break, at Mabee's waste wier, which occurred on the night of October 14th, 1865. A portion of the waste wier and one hundred feet in length of the berme bank was carried out to a depth of six feet below canal bottom. Temporary repairs made, were sufficient to obtain navigation in the shortest time.

Permanent repairs were made, and the waste weir and discharge channel reconstructed during the following winter and spring, at an expense of \$12,279.36, of which amount \$7,279.36 was paid by the State.

WORK UNDER CONTRACT DURING THE YEAR.

On the contracts for bottoming sections No. 291, 292, 294, 295, 296, 321 and 322, nothing has been done during the year.

I would reiterate the recommendation of last year's report, that means be provided for the completion, during the coming winter, of the work contemplated in these contracts.

The estimated cost to complete is \$25,200.

The work embraced in the contracts for sections No. 361, 362, 364, 365 and 366, between Tonawanda and Black Rock, has been completed.

A contract was entered into for dredging a channel below the ship lock, at Black Rock, and has been completed.

The work of dredging a portion of the Erie basin, at Buffalo, is not yet finished.

For complete information, in regard to the above-mentioned work, attention is called to annexed table, No. 2.

MISCELLANEOUS REPAIRS.

Among the important improvements and repairs of a miscellaneous character, made during the year under the supervision of this department, are the following:

Repairing break at Mabee's waste weir, previously mentioned. Stopping leak and securing culvert at Shelby basin, at an expense of \$2,794.50.

There has been expended the further sum of \$3,329.78 in filling on the face of the towing path high bank, near Four Mile Grocery. Previous to the adoption of this plan, the embankment was constantly sliding off on the outside, as the result of heavy rains and the leaching of water through the bank. Large sums have been expended in the way of outside protection, but not with entire success. The present plan of filling on the inside face of the bank, and cutting off on berme, to preserve water-way, has proved effectual, and the farther sum of \$2,500 will finish the improvement and render the bank entirely secure.

The weigh lock discharge and State house lot have also been improved and made convenient and safe, at an expense of \$3,429.55.

Stone protection has been placed at different points on repair section No. 12, and the repairs of the break of March 17, 1865, on repair section No. 11, have been completed, at an expense of \$15,968.72.

For a detailed statement of this class of work done, see annexed table No. 3.

WORK REQUIRED TO BE DONE DURING NEXT FISCAL YEAR.

This division of the Erie canal has been kept in very efficient condition during the past season, and can be so maintained at a moderate outlay in the way of extraordinary repairs on the part of the State.

A protection wall is required on the rear of a portion of the towing path bank on section No. 366, where the bank has to sus-

tain the wash of Niagara river. At all times the current of the river is very rapid and in high winds carries off immense quantities of earth from the bank, and with greater facility from the fact that it is constructed of a clay which, when saturated with water runs off very readily into the river. The estimated cost of this improvement is \$8,700.

The old tow path docking on section No. 368, between Black Rock Ferry and Black Rock is worn out. This docking was built many years ago of old timber, and was not started at bottom of canal. As a consequence, it is being constantly undermined, the bottom pushed out and large holes made in the towing path by the action of the water, requiring a large annual outlay to keep it in passable and safe condition.

Piles have also been driven along the bottom of this old dock to retain it in place, but as they could be driven but a short distance, in consequence of their striking the rock, they have also been pushed over and out of shape in such a way as to obstruct the passage of the tow lines over them.

The improvement recommended consists in straightening the towing path by sinking cribs of timber outside of the present docking to canal bottom and constructing thereon a vertical wall commencing at low water and extending to top bank. The estimated cost is \$54,300.

The lower part of Black Rock harbor fills up very rapidly, as the result of deposits from the city sewers and sand from the lake shore. To remedy, this as far as possible, and retain without constant dredging the full advantage of the harbor, it is recommended to construct a jetty, consisting of piles closely driven, 700 feet in length near the head of the harbor, thus contracting the channel opening to about 300 feet in width.

The lower part of the harbor should also be dredged out to accommodate vessels and to increase the facilities for feeding the Erie canal east. During the past season a portion of the State pier along the harbor has been tightened with gravel, which has had the good effect of saving a vast amount of water, diminishing the current in channel and raising the water in the harbor about nine inches. There still remains about 1,300 feet of same, which should be improved in like manner. It is also desirable that the channel at the entrance of ship lock at Black Rock, and also below it, should be somewhat enlarged.

The estimated cost of these several items of work is \$14,600.

The great increase in the number of elevators, coal and lumber yards along the Erie basin in the city of Buffalo requires that the channel should be excavated to its full dimensions of 300 feet width and $13\frac{1}{2}$ feet deep, to accommodate the business interests there located. The entrance to this basin at the south end of the breakwater is not considered of sufficient capacity to accommodate the navigation.

It is therefore recommended to dredge out a new channel at the north end of the breakwater, 300 feet wide and about 900 feet long.

The estimated cost of this improvement is \$17,500.

The Main and Hamburg street canal in the city of Buffalo requires some important improvements.

The canal is so shallow that at times of low water in the lake there is none at all in this canal, and the liquid mud in the bottom becomes malarious and a public nuisance. The sides of the canal, having neither wall nor docking, affords but slight facilities for the lading and unlading of boats.

The whole canal should be dredged out for a distance of about 5,000 feet, as originally contemplated by a resolution of the Canal Board, and the towing path walled or docked for a distance of about 3,000 feet.

The estimated cost is \$36,700.

The towing path near Rochester weigh lock was originally finished with a plank facing on the inside. Much trouble has been experienced in keeping this facing in place, in consequence of the collection of water let down against it from the drain from dwellings adjacent, and the action of the frost upon it thus circumstanced. This facing is decayed and nearly worn out, and I therefore recommend that there be constructed in its place a durable vertical wall, at an estimated cost of \$10,400 over cost on original plan.

Much inconvenience and delay have been experienced in operating the weigh lock at Rochester in consequence of the contracted and tortuous channel of the canal east and adjacent to it. It should be improved by straightening the berme line and the construction of a vertical wall for a short distance. Estimated cost, \$7,300.

The vertical wall west of the Rochester weigh lock between the canal and mill race should be raised to protect and secure the towing path bank, at an estimated expense of \$1,800.

The timber bridges on this division will mostly have to be rebuilt within the next three years, and probably nearly one-quarter of the whole number next season.

This class of bridges have to be rebuilt as often as once in eight to ten years. I would respectfully recommend that when rebuilt, iron should be substituted in towns and villages and on great thoroughfares, and in all other cases where it is not thought advisable at present to reconstruct entirely of iron, that iron chords and shoes be substituted for the present plan.

Believing this to be the true policy, I have estimated as necessary for such change of plan on this division the coming year, \$20,000.

In the following statement I have designated the more important items of work, with their estimated cost, which, in my opinion, requires to be done the coming season:

| | |
|---|---------|
| Protection wall on rear of towing path bank, on section No. 366, to protect bank from the wash of Niagara river | \$8,700 |
| Vertical wall in place of timber facing on towing path east of and opposite to weigh lock at Rochester..... | 10,358 |
| Straightening line on berme from Rochester weigh lock to Griffith street bridge | 7,300 |
| Complete a vertical wall west of Rochester weigh lock, outside of towing path, along the mill race..... | 1,800 |
| Complete the filling in and securing the towing path high bank near Four Mile grocery..... | 2,500 |
| Raising, enlarging and securing banks | 44,000 |
| Changing plans of bridges | 20,000 |
| Completing the Clark & Skinner canal..... | 20,000 |
| Straightening tow path and construction of a vertical wall on Sec. No, 368, between Black Rock and Black Rock ferry | 54,300 |
| Constructing a pile jetty at entrance to Black Rock harbor, and other improvements..... | 14,600 |
| Improvement of Erie basin | 17,500 |
| Improvement of Main and Hamburgh street canal, at Buffalo | 86,700 |

GENESEE VALLEY CANAL.

There have been several small breaks on this canal during the past season, causing at each a short detention to navigation. The

principal one of these was the leak at Haskill's Creek waste weir on the extension, which took several days to repair. The leak was caused by the settling of the inside wings of the abutments, which were not secured on a proper foundation when built. Repairs were made by taking up the wings and surrounding the ends with a bank of earth. This structure will require to be overhauled, and the wings rebuilt on a pile foundation during the coming winter. The estimated cost of the work required is \$1,600. In the present condition of this canal, with its old and worn out structures, built on cheap, and in some cases defective plans originally, the most careful attention will fail to guard against often recurring casualties of this character.

PRESENT CONDITION OF WORK UNDER CONTRACT DURING THE YEAR.

The contracts for constructing locks of stone in place of wood locks have been completed. Locks No. 11, 15, 31, 38 and 53 have been thus rebuilt on change of plan and brought into use.

In the reconstruction of these locks it was found that the lower courses of timber in the old lock chambers for from eight to ten feet from the bottom were sound and in a good condition, and only the top six or eight feet decayed. In view of this fact I would recommend the remaining eight wood locks on section No. 2, should be repaired by taking out the decayed timber and replacing with new, the earth taken from the rear of the side walls, and they pressed back and tied in their places, the lower wings rebuilt of timber, and new gates and valves be inserted during the coming winter. I recommend this plan as being much cheaper than that of rebuilding of stone, and believe that thus repaired these locks will prove efficient and stand for many years. This plan also diverts the services of a less number of laborers in the spring from the ordinary repairs of the canal, a consideration of importance in that locality, where labor at the best is scarce, and where so much of it is required every spring to put the canal in navigable order.

There remain eight locks of this character, designated as locks No. 14, 17, 18, 19, 30, 37, 39 and 40, all of which should be repaired at an early date, and more than half of them can hardly be expected to last another season without the repairs above-mentioned.

The estimated cost per lock on this plan is..... \$7,000 00

The culvert under the canal on section 66 has been completed and brought into use at an expense of --- \$1,500 00
For details of this class of work reference is made to table No. 2, hereto annexed.

MISCELLANEOUS REPAIRS.

Among the miscellaneous repairs done under direction of the Canal Commissioner are the following :

| | |
|---|-----------|
| Protecting canal bank on repair section No. 3, at a cost of \$2,063 94 | |
| Reconstructing portions of wing and securing lower end of Piffardinia waste weir on repair section No. 1, at a cost of..... | 1,189 22 |
| There has been paid the further sum of..... | 34,630 00 |
| for repairing the breaks of March 17th, 1865, on repair section No. 1. See annexed table No. 3. | |

WORK REQUIRED TO BE DONE DURING NEXT FISCAL YEAR.

The north timber trunk at Portage is in a very dilapidated and unsafe condition. Work amounting to about \$7,000 was done in the spring of 1864, with a view of replacing this trunk with a prism and banks of earth, supported on the rear with stone. Since that time no money has been provided to complete the work, and every season large quantities of the earth, already placed for bank, are washed away by leakage from the old trunk and the surface water. I fear that the old trunk will not stand another season, and I trust provision will be made for the speedy completion of the earthwork contemplated in the work already commenced, to replace the timber trunk. The estimated cost is \$19,000.

Much detention has occurred in years past from lack of water to supply the Cuba summit. To remedy this, act, chap. 170, Laws of 1864, was passed, which provides for taking Lime lake as a reservoir. No funds have as yet, however, been provided for the construction of the work, and it has not been commenced.

The following description of this lake is taken from the report of O. W. Storey, as embraced in the State Engineer's report for 1865, page 82 :

"Lime lake is about one mile long, north and south, and has an average width of about sixty rods. It is located in the north part of the town of Machias, in the county of Cattaraugus, and is a part of the head of Cattaraugus creek, consequently its waters flow into Lake Erie. It is contemplated to make the reservoir about one

and a half miles long, with an average width of ninety rods, by building a bank at the north end twenty-two chains long, and one across the swamp at the south end seventeen chains long, of sufficient height to raise the water fifteen feet above the present surface of the lake. It is also contemplated to draw the lake eight feet below the present surface.

"The reservoir is to be filled from the Ischua creek during the spring flood; also to hold a portion of its surplus waters in summer freshets."

For use in dry weather the water is to be passed down Ischua creek to the present canal feeder, a distance of about fifteen miles. The cost of the work is estimated at \$160,000. With the reservoir constructed, and the aqueduct, waste weirs and lock valves made tight, and the water in every other way properly husbanded, I believe the canal could be supplied with sufficient water the driest season through, for the purposes of navigation.

The Ischua feeder aqueduct, about one mile north of Hinsdale, is worn out. The timber is very much decayed, and the piers and one abutment in a precarious condition. A part at least of this structure should be rebuilt during the ensuing winter and spring. The original plan on which it was built was very defective. The present structure is three hundred and sixty feet in length, passing the feeder water over Oil creek and the deep valley through which it flows. This feeder is one of the main sources from which that portion of the canal is supplied with water, and will become still more important after the construction of Lime Lake reservoir, which will also discharge its waters through this feeder. In no case should the aqueduct be reconstructed on the original plan, and in view of its present and prospective importance it should be reconstructed in a stable and permanent manner.

Ischua feeder should be widened and the banks raised, to enable it to pass more water, as during the dry season, when Oil Creek reservoir is exhausted, it is almost the only source of supply for the summit canal. The estimated cost is \$3,000.

There are many lesser items of work which equally require to be done during the ensuing year, which I have designated in detail in the following statement.

WORK RECOMMENDED TO BE DONE DURING COMING YEAR.

| | |
|---|----------|
| Constructing a prism and bank of earth in place of the north timber trunk at Portage..... | \$19,000 |
| Protecting the canal at Griffin creek, Cuba | 3,600 |
| Guard bank from the bulkhead of Caneseraugus creek feeder along the creek to protect canal and feeder from floods..... | 1,300 |
| Repairing timber locks Nos. 14, 17, 18, 19, 30, 37, 39 and 40, by renewing part of chambers and lower wings | 56,000 |
| Guard bank from Rapids lock to the railroad embankment near Rochester, to protect canal from floods.... | 8,000 |
| Securing the towing path slide bank near Brushville with slope wall and gravel lining | 675 |
| Constructing two sluices under towing path near lock No. 31 to convey small streams into canal | 450 |
| Securing and strengthening Haskell creek waste weir by relaying a portion of the abutments of same on a pile foundation | 1,600 |
| Protecting canal bank where Champlain creek empties into it | 350 |
| Protecting canal bank where Black creek empties into it, | 200 |
| Making a reservoir of Lime lake | 160,000 |
| Making a waste weir safe on Portage level | 1,000 |
| Raising towing path bank at Smith's Mills, south of Hinsdale, to prevent flood waters of Olean creek from flowing into it | 1,400 |
| Enlarging and raising towing path west of Cuba waste weir | 2,000 |
| Rebuilding bridge at Hunter street, Rochester (change of plan) | 5,000 |
| Reconstructing Ischua feeder aqueduct near Hinsdale .. | 20,000 |
| Protecting canal bank opposite and below lock No. 69 with stone and brush | 6,000 |
| Constructing bulkhead and gates to use Smith's mill-pond, near Hinsdale, for a feeder | 1,200 |
| To change channel of creek on Breed & Gay's land north of Cuba | 500 |
| Widening channel and raising banks of Ischua feeder.. | 3,000 |
| Widening channel of canal in cuts at Dumplin Hill and other places | 3,000 |

**WORK AUTHORIZED BY ACT OF LEGISLATURE, BUT NOT YET
COMMENCED.**

| | Amount of appropriation. | Estimated cost. |
|--|-----------------------------|--------------------|
| Erie canal: | | |
| Sewer in the city of Lockport | \$5,000 | \$10,000 |
| Raising canal banks through the city of Ro- chester | 25,000 | 26,600 |
| Alterations in Genesee River dam near Ro- chester | 5,000 | 2,400 |
| | <u>\$35,000</u> | <u>\$39,000</u> |
| Genesee Valley canal: | | |
| Reconstruction State road bridge at Nunda .. | | \$4,128 |
| Improvement at Moscow landing | \$3,000 | 5,000 |
| Construction Lime Lake reservoir | | 160,000 |
| Building iron bridge at Tremont street, Ro- chester : | 7,500 | 7,000 |
| | <u>\$10,500</u> | <u>\$176,128</u> |

Respectfully submitted,

W. W. JEROME,

Acting Division Engineer.

TABLE No. 1.
REPAIRS.

Statement showing name, number of days and compensation of Engineers upon the repairs of the Western Division of the New York State canals, together with incidental expenses during the fiscal year ending September 30, 1866, under Act chapter 169, Laws of 1863.

ERIE CANAL.

| NAMES. | RANK. | Number of days. | Rate of compensation. | Amounts. | Totals. |
|----------------------------------|--------------------------------|-----------------|-----------------------|----------|------------|
| Orville W. Story..... | Division Engineer..... | ----- | \$2,000 00 | \$550 00 | |
| Orville W. Story..... | Division Engineer, travel..... | ----- | | 105 34 | |
| W. W. Jerome..... | Resident Engineer..... | ----- | 1,700 00 | 1,481 60 | |
| W. W. Jerome..... | Resident Engineer, travel..... | ----- | | 353 64 | |
| George Arnoldt..... | Assistant Engineer..... | 45 | 4 50 | 202 50 | |
| Newton E. Storey..... | Draughtsman..... | 110 | 1 75 | 192 50 | |
| Newton E. Storey..... | Draughtsman..... | 20 | 2 00 | 40 00 | \$2,925 58 |
| <i>Incidental Expenses.</i> | | | | | |
| Stationery..... | | | | \$198 84 | |
| Fuel, light and office rent..... | | | | 268 68 | |
| Postage and telegraph..... | | | | 136 66 | |
| Miscellaneous..... | | | | 138 45 | 742 63 |
| Total for Erie canal..... | | | | ----- | \$3,668 21 |

GENESEE VALLEY CANAL.

| | | | | |
|-----------------------------------|--------------------------------|------------|------------|------------|
| [Orville W. Story..... | Division Engineer..... | \$2,000 00 | \$950 00 | |
| Asscm. Orville W. Story..... | Division Engineer, travel..... | | 194 66 | |
| W. W. Jerome..... | Resident Engineer..... | 1,700 00 | 218 40 | |
| W. W. Jerome..... | Resident Engineer, travel..... | | 46 36 | |
| c. George Arnoldt..... | Assistant..... | 4 50 | 112 50 | |
| Newton E. Story..... | Draughtsman..... | 2 00 | 22 00 | |
| | | | | \$1,543 92 |
| <i>Incidental Expenses.</i> | | | | |
| Stationery..... | | | \$83 63 | |
| Fuel, light and office rent..... | | | 112 11 | |
| Postage and telegraph..... | | | 72 73 | |
| Miscellaneous..... | | | 69 45 | |
| | | | | 337 92 |
| Total for Genesee Val. canal..... | | | | \$1,881 84 |
| <i>Recapitulation.</i> | | | | |
| Erie canal..... | | | \$3,668 21 | |
| Genesee Valley canal..... | | | 1,881 84 | |
| | | | | \$5,550 05 |

TABLE No. 1.—Continued.

EXTRAORDINARY REPAIRS.

Statement showing the Assistants temporarily employed on Extraordinary Repairs paid by Canal Commissioner during the fiscal year ending September 30, 1866, under act chapter 169, Laws of 1863.

ERIE CANAL.

| NAMES. | RANK. | Number of days. | Rate of compensation. | Amounts. | Totals. |
|-------------------------|-------------------------|-----------------|-----------------------|----------|------------|
| George Arnoldt..... | Assistant Engineer..... | 82 | \$4 50 | 369 00 | |
| J. Frederick Behn..... | Assistant Engineer..... | 40 | 4 00 | 160 00 | |
| Jasper S. Youngs..... | Assistant Engineer..... | 234 | 3 50 | 819 00 | |
| John A. Ditto..... | Assistant Engineer..... | 192 | 3 50 | 672 00 | |
| William Richardson..... | Inspector..... | 52 | 2 50 | 130 00 | |
| John B. Elliot..... | Inspector..... | 215 | 2 50 | 537 50 | |
| Henry Flanigan..... | Inspector..... | 26 | 3 00 | 78 00 | |
| William Sime..... | Rodman..... | 34 | 2 25 | 76 50 | |
| Elias W. Beach..... | Rodman..... | 78 | 1 75 | 136 50 | |
| William McCrae..... | Rodman..... | 6 | 2 00 | 12 00 | |
| Loomis Lyman..... | Rodman..... | 5 | 2 00 | 10 00 | |
| William Richardson..... | Axeman..... | 12 | 2 00 | 24 00 | |
| Samuel C. Tibbits..... | Axeman..... | 28 | 2 00 | 56 00 | |
| | | | | | \$3,071 50 |

| | | | | | |
|-------------------------------------|------------------------------|----|--------|----------|-------------------|
| <i>Incidental Expenses.</i> | | | | | |
| D. D. S. Brown..... | Printing specifications..... | | | | 10 75 |
| Total for Erie canal..... | | | | | <u>\$3,082 25</u> |
| GENESEE VALLEY CANAL. | | | | | |
| Byron Holley | Assistant Engineer..... | 40 | \$4 50 | \$180 00 | |
| George Arnoldt..... | Assistant Engineer..... | 4 | 4 50 | 18 00 | \$198 00 |
| Total for Genesee Valley canal..... | | | | | <u>\$198 00</u> |

TABLE No. 1.—Continued.
TEMPORARY REPAIRS.
Statement showing the Assistants employed on Temporary Repairs during the fiscal year ending September 30, 1866, and paid by Canal Commissioner or by the Superintendent of Repairs.

ERIE CANAL.

| NAMES. | RANK. | Number of days. | Rate of compensation. | Amounts. | Totals. |
|-------------------------|--------------------------|-----------------|-----------------------|----------|-------------------|
| Byron Holley ----- | Assistant Engineer.----- | 23 | \$4 50 | \$103 50 | \$2,223 00 |
| George Arnoldt.----- | Assistant Engineer.----- | 69 | 4 50 | 310 50 | |
| J. Frederick Behn ----- | Assistant Engineer.----- | 325 | 4 00 | 1,300 00 | |
| Jasper S. Youngs.----- | Assistant Engineer.----- | 78 | 3 50 | 273 00 | |
| S. F. Gooding.----- | Inspector ----- | 59 | 4 00 | 236 00 | |
| GENESEE VALLEY CANAL. | | | | | |
| Byron Holley ----- | Assistant Engineer.----- | 131 | \$4 50 | \$589 50 | 787 50 |
| George Arnoldt.----- | Assistant Engineer.----- | 44 | 4 50 | 198 00 | |
| | | | | | <u>\$3,010 50</u> |

LOCKS OF STONE IN PLACE OF WOOD LOCKS.

Statement showing the Assistants employed and expenses incurred on Locks of Stone in place of Wood—Locks as contemplated under act chapter 170, Laws of 1864.

GENESEE VALLEY CANAL.

| NAMES. | RANK. | Number of days. | Rate of compensa- tion. | Amounts. | Totals. |
|-----------------|--------------------|--------------------|----------------------------|----------|------------|
| Byron Holley | Assistant Engineer | 118 | \$4 50 | \$531 00 | |
| J. Nelson Tubbs | Assistant Engineer | 86 | 4 50 | 387 00 | |
| George Arnoldt | Assistant Engineer | 45 | 4 50 | 202 50 | |
| Newton E. Story | Rodman | 48 | 2 00 | 96 00 | |
| William Dawson | Inspector | 50 | 3 50 | 175 00 | |
| William Dawson | Inspector | 61 | 4 00 | 244 00 | |
| George B. Allen | Inspector | 42 | 3 50 | 147 00 | |
| George B. Allen | Inspector | 61 | 4 00 | 244 00 | |
| | | | | | \$2,026 50 |

SUMMARY OF TABLE No. 1,
Showing engineering expenses for fiscal year.

| NAME OF CANAL. | Engineering proper. | Incidental expenses. | Amount. | Total. |
|---|------------------------|-------------------------|-------------|-------------|
| Repairs of Erie ----- | \$2,925 58 | \$742 63 | \$3,668 21 | |
| Extraordinary repairs of Erie ----- | 3,071 50 | 10 75 | 3,082 25 | \$6,750 46 |
| Repairs of Genesee Valley ----- | 1,543 92 | 337 92 | 1,881 84 | |
| Extraordinary repairs of Genesee Valley ----- | 198 00 | ----- | 198 00 | 2,079 84 |
| Locks of stone in place of wood, Genesee Valley ----- | 2,026 50 | ----- | 2,026 50 | 2,026 50 |
| Total ----- | \$9,765 50 | \$1,091 30 | \$10,856 80 | \$10,856 80 |

TABLE No. 2.

Statement showing the character of work, estimated cost at contract prices, the amount done during the fiscal year ending September 30th, 1866, and the amount remaining to be done on work under contract on the Western Division of the New York State canals.

| CHARACTER OF WORK. | Estimated cost at contract prices. | Amount done during fiscal year. | Total amount done. | Amount remaining to be done. |
|--|------------------------------------|---------------------------------|--------------------|------------------------------|
| ERIE CANAL. | | | | |
| Sections No. 291, 292 and 294 | \$29,150 00 | ----- | \$18,060 00 | \$11,090 00 |
| do 295, 296 | 16,200 00 | ----- | 9,000 00 | 7,200 00 |
| do 321, 322 | 9,460 00 | ----- | 2,560 00 | 6,900 00 |
| do 361 | 46,014 30 | ----- | 46,014 30 | Completed. |
| do 362 | 26,287 36 | \$680 67 | 26,287 36 | do |
| do 364, 365 | 45,044 16 | 14,190 93 | 45,044 16 | do |
| do 366 | 50,101 23 | 31,473 88 | 50,101 23 | do |
| Improvement of Oak Orchard creek | 45,460 00 | 16,711 80 | 40,583 98 | 4,876 02 |
| Dredging channel below ship lock, Black Rock | 2,109 00 | 17,101 68 | 2,109 00 | Completed. |
| Dredging a portion of Erie basin | 6,000 00 | 2,109 00 | 5,820 00 | 180 00 |
| Erie street bridge, Buffalo | 16,300 00 | 5,820 00 | 10,860 00 | 5,440 00 |
| | \$292,126 05 | 10,860 00 | \$256,440 93 | \$35,686 02 |

TABLE No. 2—Continued.

| CHARACTER OF WORK. | Estimated cost at contract prices. | Amount done during fiscal year. | Total amount done. | Amount remaining to be done. |
|--------------------------------|------------------------------------|---------------------------------|--------------------|------------------------------|
| GENESEE VALLEY CANAL. | | | | |
| Lock No. 11..... | \$15,884 62 | \$10,900 00 | \$15,884 62 | Completed. |
| do 15..... | 16,720 47 | 13,520 47 | 16,720 47 | do |
| do 31..... | 15,073 87 | 12,100 00 | 15,073 87 | do |
| do 38..... | 16,041 20 | 14,040 00 | 16,041 20 | do |
| do 53..... | 15,582 87 | 10,362 87 | 15,582 87 | do |
| Tremont street bridge..... | 7,000 00 | ----- | ----- | \$7,000 00 |
| Culvert on section No. 66..... | 1,500 00 | 1,500 00 | 1,500 00 | Completed. |
| | \$87,803 03 | \$62,423 34 | \$80,803 03 | \$7,000 00 |

TABLE No. 3.

Statement showing amount of work done under supervision of Engineer Department on miscellaneous repairs authorized by Canal Board and by the Canal Commissioners, and amount paid thereon during fiscal year ending September 30th, 1866.

| CHARACTER OF WORK. | Amount ap- propriated. | Amount done. | Amount paid. |
|---|---------------------------|--------------|--------------|
| ERIE CANAL. | | | |
| Strengthening roadways of Commercial Street bridge | \$450 00 | \$450 00 | \$450 00 |
| Rebuilding bridge over slip No. 2, (difference in cost) | 200 00 | 200 00 | 200 00 |
| Composite valves and wheels, and chain levers in Lockville locks | --- | 515 34 | 515 34 |
| Rebuilding receiver and discharge, at Discharge culvert, Lockport | --- | 311 70 | 311 70 |
| Stopping leaks at Shelby Basin culvert | --- | 2,794 50 | 2,794 50 |
| Securing and strengthening high embankment at Four Mile grocery | --- | 3,329 78 | 3,329 78 |
| Repairing break at Mabee's waste weir | --- | 12,279 36 | 12,279 36 |
| Securing docking on slip No. 2, Buffalo | --- | 647 32 | 647 32 |
| Improving weigh lock discharge and yard | --- | 3,429 55 | 3,429 55 |
| Graveling towing path, section No. 12 | --- | 365 00 | 365 00 |
| Protecting bank with stone on section No. 12 | --- | 972 13 | 972 13 |
| Reconstructing Amherst St. bridge, on State ditch, Black Rock, (change of plan) | --- | 830 27 | 830 27 |
| Reconstructing military road over State ditch, Black Rock | --- | 746 12 | 746 12 |
| Repairing the breaks of March 17, 1865, repair section No. 14 | --- | 380 90 | 380 90 |

TABLE No. 3—Continued.

| CHARACTER OF WORK. | Amount ap- propriated. | Amount done. | Amount paid. |
|---|---------------------------|--------------|--------------|
| Repairing the breaks of March 17, 1865, repair section No. 11—work done in 1865, \$13,540 | ----- | \$15,968 92 | \$15,968 92 |
| Total | \$650 00 | \$43,220 89 | \$43,220 89 |
| GENESEE VALLEY CANAL. | | | |
| Protecting canal banks, repair section No. 3 | ----- | \$2,063 94 | \$2,063 94 |
| Reconstructing portions of the wing, and securing lower end of Piffardinia waste weir, repair section No. 1 | ----- | 1,189 22 | 1,189 22 |
| Repairing the breaks of March 17, 1865, repair section No. 1 | ----- | 34,630 00 | 34,630 00 |
| Total | ----- | \$37,883 16 | \$37,883 16 |

REPORT OF COMMISSIONERS, UNDER ACT CHAPTER 491, LAWS OF 1866, FOR THE IMPROVEMENT OF THE HUDSON RIVER.

During the past season the Commissioners appointed under the above named act, by which one hundred and fifty thousand dollars was appropriated, to be expended in the improvement of the Hudson river, have, as indicated in the report of the commission of 1865, caused the principal expenditure in the correction of the then formidable obstruction at Willow Island bar, situated near New Baltimore.

A longitudinal dyke or pier has been constructed at this point, 4,507 feet in length, averaging 14 feet in width, and in a depth of water varying from 3 to 16 feet, averaging 11 feet at ordinary high tide. In its construction, 212,532 feet of piles have been driven, 78,456 feet of pine and 142,836 feet of hemlock timber, 38,713 pounds of rods, bolts and spike, 15,352 cubic yards of rough stone, 8,536 yards of stone chips, and 5,074 yards of slope wall stone have been used.

The cost of materials and labor has been \$110,951.97.

The wood work and filling is completed as far as constructed, except the surface slope wall, of which 4,800 square feet is laid, leaving 45,660 square feet to be completed.

A dyke has been commenced—924 feet of which has been constructed—across the mouth of Schodack channel, the pileing, timber work and stone filling of which has been completed for the distance named. No part of the surface slope wall has been laid.

Cuyler's dyke, constructed in 1865—but left in an unfinished state—has been completed. Coeymans dyke has been extended along the face of Mull's island 460 feet, forming a half dyke. Castleton dyke has been repaired, a large amount of excavation by dredges done at the new dyke near New Baltimore, at Round shoals, Fish House bar, at Castleton, and at the upper end of the U. S. dyke below Albany.

Dredging at the last named point, at a cost of \$9,215, became necessary, in consequence of a new and formidable shoal, of material deposited in the channel by reason of an ice dam, formed during the freshet at the breaking up of the river. Previous to

its removal much detention was experienced, as well as a considerable loss of property by grounding of vessels and collisions.

EXPENDITURES.

| | |
|--|--------------|
| Construction of Baltimore dyke, 4,507 feet..... | \$100,951 97 |
| Construction of Schodack dyke, 924 feet | 9,293 15 |
| Extending Coeymans dyke 460 feet (half dyke).... | 1,930 85 |
| Completing Cuyler's dyke, commenced in 1865.... | 4,570 94 |
| Repairing Castleton dyke..... | 326 10 |
| Repairing U. S. dykes..... | 290 32 |
| Dredging new shoal at the head of U. S. works below Albany, caused by daming of ice in spring freshet..... | 9,215 00 |
| Dredging Willow Island bar at Baltimore dyke ... | 14,443 00 |
| Dredging at Castleton..... | 507 50 |
| “ Kellogg shoals | 1,274 00 |
| “ Round shoals | 2,156 00 |
| “ Fish House Bar | 5,527 00 |
| Materials on hand | 5,909 50 |

Miscellaneous Disbursements.

| | |
|---|--------------|
| Removing wrecks, stumps and other obstructions, placing buoys, lights, &c | 3,074 00 |
| | <hr/> |
| | \$159,469 33 |

RESOURCES.

| | |
|--|------------|
| Unexpended, of appropriation of 1865, \$9,469 33 | |
| Appropriation of 1866..... | 150,000 00 |
| | <hr/> |
| | 159,469 33 |

To complete the works commenced will require, as near as can be estimated, the following sums:

| | |
|--|-------------|
| To construct and extend Baltimore dyke, 1,365 feet | \$32,268 60 |
| To complete slope wall of portion now constructed..... | 5,609 34 |
| | <hr/> |
| | \$37,877 94 |
| To construct and extend Schodack dyke, 1,914 feet, | 27,146 83 |
| Dredging | 25,000 00 |
| | <hr/> |
| | \$90,024 77 |

If the Legislature decide to continue the work, by making an appropriation of a similar amount as that of the past year, it is proposed to expend the balance, after completing the unfinished work, in the construction of dykes between Troy and Albany.

Various plans for the improvement of the Hudson river have, from time to time, been discussed. Some of them have been partially carried into operation, and all have differed essentially in some material points.

The magnitude of the interests involved, and the danger of theorizing in a matter of so much delicacy as the action of freshets, currents and tides, has caused those whose duty it has been to consider the subject, no small degree of embarrassment.

The Commissioners appointed by the Legislature "to control and expend" the appropriations of 1863, 1864, 1865 and 1866, entered upon their duties feeling the same embarrassment, and have proceeded in the performance of the trust confided to them with caution.

Having now had the benefit of the several surveys, the reports of which, accompanied by maps, have been carefully studied, and the changes in the bed of the river noticed and traced to their cause, with their own observation during four years of experience, the Commissioners feel better able to consider and to decide as to the mistakes and errors committed, as well as to what, in their opinion, is the most feasible and practicable mode of improvement.

The following plans have been proposed:

At an early day "wing dams" were constructed, from the shores in the neighborhood of shoals, to contract the channel and cause the freshets to disperse them.

A project of a ship canal from Albany to New Baltimore was considered, surveys made, and estimates submitted. It was proposed to construct a canal of the following dimensions, 35 feet wide, 18 feet deep, and $12\frac{3}{4}$ miles long, at a cost of \$1,202,365; or, for a canal 300 feet wide, at a cost of \$2,174,640.

Another project for a canal was considered, and submitted to a committee appointed by the city of Albany, 12 miles long, 120 feet wide, 20 feet in depth, with locks to pass vessels 300 feet long and 50 feet wide, at an estimated cost of \$2,450,000, and an annual expense of \$75,000. It was proposed to elevate the canal 20 feet above the surface of the river, and to supply the water by steam power, at an additional cost for engines and pumps of \$180,000, or by reservoirs, at a cost of \$428,100, using neighboring streams to fill them.

It has also been proposed, "by the greater or less contraction of the width, to obtain a corroding action of the freshets by using *high* longitudinal dykes, 7, 8 and 9 feet above ordinary high

water," depending mainly on such means to scour out a channel, ignoring the ebb and flood tide action, and conclude their influence to be so slight as not to be worthy of consideration.

From 1835 to 1839 this system was being carried out under the direction of Capt. Henry Brewerton, with appropriations from Congress, when the operations were suspended in consequence of change of policy as to internal improvements

Major Delafield, in 1852, by direction of Congress, made a full and elaborate survey of the condition of the river. He condemns *high* dykes and wing dams, and considers the scouring process of freshets, recommended to be used by former engineers, an evil.

Large sums have been appropriated by the Legislature, by the cities of Troy and Albany, by subscriptions, and by individuals interested in the navigation of the river for dredging, with great but *temporary* benefit.

The construction of wing dams has been a fatal error, causing the damming of the ice, by reason of which extensive shoals have been formed; have increased the height and prolonged the duration of the floods which have been so disastrous, by inundating the cities and villages above them; have deflected the currents, cutting away the banks, and transferring shoals from place to place, and have checked the velocity and rise of the tides in their upward flow.

Maj. Delafield says, in his report, that "they add artificial to natural obstructions, and make the river worse than when left to itself."

The longitudinal dykes built under the direction of the U. S. engineers, have been productive of great good, having eradicated the "overslaugh" and several other bars, the importance of which to the navigation of the river has been, and is, incalculable. The cross dams connecting them with the shore, at intervals forming basins, have been unwisely constructed, for sanitary and other reasons. They are unnecessary, serve no good purpose, and have contributed to the dilapidation of the principal structures.

The recommendation of high dykes and a sufficient contraction of the river to scour out a channel by the abrading power of the freshets, without recourse to dredging, and to ignore the effects of the tides, was undoubtedly a grave error.

The great evil to be guarded against is the corroding and abrading scour of the bed of the river, and the wearing away of the banks by the action of the freshets. Undue contraction of the

width, gaining thereby undue velocity to disturb the bed of the river, is disastrous, as it serves but to change the locality of the evil sought to be corrected.

A canal would have restricted and embarrassed the trade, and would now be utterly inadequate to accommodate the present and increasing traffic of the river. It was fortunate for the interests of the State canals, and of the cities of Troy and Albany, that the project was abandoned.

Dredging as a remedy is not only expensive, but is *temporary* in its effects, as, without some means of maintaining the required depth permanently, after shoals have been removed, the same causes by which they were originally created will reproduce them.

For example, the corporation of the city of Troy has expended each year, from 1825 to 1867—(in addition to the amount expended by the State)—sums reaching the aggregate of \$127,248⁵⁹/₁₀₀, in dredging, which would have been almost entirely unnecessary, had longitudinal dykes been constructed and properly located, in place of the construction of wing dams.

The greatest obstructions are usually found where the river has attained an unusual width, and where, by the spread of the water, its velocity is diminished, and a consequent deposit of material is constantly going on, forming bars and shoals.

The system of improvement acted upon and recommended is: To gain the desired depth and width by dredging; to narrow the river, and confine the currents and tides in the channel excavated by single or parallel piers or dykes, restoring a velocity sufficient to prevent deposit of material; to widen by cutting off points where it is too much contracted to allow the free passage of the flood tides; to protect the banks from wearing away, and to close up side channels,

Low structures are used, and care taken to avoid too much contraction, in order to prevent a disturbance of the bed by a scouring process. They allow freshets and ice to pass over them, and, by being often submerged, decay of timber used in their construction is prevented. They must be substantial, to prevent undermining and to resist the pressure and abrasion of the ice.

By thus controlling and leading the freshets and ebb and flood tides in the same courses by easy and gentle curves, decreasing friction and removing obstructions, in addition to the gain of depth by the use of the dredge, there is also a gain by causing the flood tides to pass up quicker and to rise higher.

The "Coast survey" observation of tides in 1856 show that there was a loss of rise and fall of tide between Stuyvesant and Albany (24 miles) of one foot and a half, while from New York to Stuyvesant (78 miles) the loss was only 5 inches.

Maj. Delafield argues "that a foot and a half may be gained at Troy and Albany by promoting the flow of the tide alone."

It has been ascertained by careful observations at Albany during the past season, that five inches of this loss has already been regained, which is manifestly due to the operations of the last four years, and there is no doubt that, by the use of proper means, all or nearly all of the loss can be made up.

In consequence of the gradual clearing up of the country adjacent to the Mohawk and upper Hudson, the rain as it falls finds its way into those streams in a much shorter space of time than in former years, causing freshets to follow more rapidly and violently, and with consequent longer intervals between the effects of the rain falls. The necessity then of leading the flood tides up more freely during such intervals—when most needed—is apparent.

From this cause—but for the artificial improvements—the navigation would have been subjected each year to increased embarrassments and delays.

The aim of the commissioners has been to provide a practicable channel of eight feet at the lowest stage of the water from Troy to New Baltimore, and from 10 to 11 at ordinary high water.

This has been attained below Albany and can be maintained by completing the works commenced and by a small annual outlay for dredging. Between Troy and Albany the same result can be accomplished by the same means. The navigation above Albany during the past season has been subjected to less detention than during any former season, in consequence of the operations below allowing the ascending tides more freedom.

When these results have been reached, if desired, by extending the operations, a wider channel, more direct, and more easily navigated can readily be obtained to accommodate vessels drawing 11 feet at ordinary low water, and 14 feet at high water.

By the decease of Thomas Schuyler, one of the members of this commission, the survivors lost an associate whose life-long knowledge of the river, its navigation and requirements; his convictions of the importance of improving this great "highway of commerce," and his business qualifications, peculiarly adapted him

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